

505—Moento loam, 0 to 15 percent slopes

Map Unit Description

This moderately deep, well drained soil is on mesas and in drainageways. The elevation ranges from 7,800 to 8,300 feet. The average annual precipitation is 18 to 22 inches. The average annual air temperature is 40 to 46 degrees F. The average frost-free period is 80 to 100 days. The soil moisture and temperature regimes are ustic and frigid, respectively.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include soils that have a mollic epipedon more than 16 inches thick. These are usually found in areas where water is most concentrated. Similar inclusions make up about 5 percent of the unit; the percentage varies from one area to another.

Brief Soil Description

Moento loam

The Moento soil formed in alluvium and slope alluvium derived mostly from sandstone. Typically the surface layer is dark brown loam about 2 inches thick. The next layer is dark brown clay loam about 4 inches thick. The upper 15 inches of the subsoil are brown clay loam, and the lower 9 inches are strong brown sandy clay loam. The substratum is reddish yellow sandy clay loam about 6 inches thick. Fractured sandstone bedrock is at a depth of 36 inches; however, the depth to bedrock generally ranges from 20 to 40 inches.

The permeability of the Moento soil is moderately slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are 5 percent Beje loam on hills and ridges, and 10 percent soils that have very little soil development and less clay in the profile along the edges of swales. Beje soils are shallow over sandstone.

Vegetation

The dominant plant association is *Festuca arizonica/Muhlenbergia montana*. The native vegetation consists mostly of Arizona fescue, western wheatgrass, mountain brome, needleandthread, mountain muhly, Kentucky bluegrass, bottlebrush squirreltail, prairie Junegrass, and sedge. Other plants that characterize this unit are mule-ears, common snowberry, and shrubby cinquefoil. The average annual production of air-dry vegetation is about 1,500 pounds per acre.

Soil Management Implications

This unit is used intensively for livestock grazing and frequently is the preferred location for the construction of water storage reservoirs (*Fig. 11*).

The mass movement potential is rated low for this unit because of the slope.

There are very few limitations to range improvement projects on this unit. In some locations, the permeability may be too rapid for effective reservoir construction. In almost all locations the productivity could be substantially increased with better livestock handling, and with practices like seeding and fertilizing.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of range vegetation. More uniform use of rangeland is aided by properly



Figure 11.—Moento loam, 0 to 15 percent slopes, is well suited to building stock ponds.

locating salt and by herding. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

This map unit is well suited to recreational development. The main limitation is the presence of slopes that are over 8 percent. Maintaining vegetative cover helps to enhance the beauty of the area.

This map unit is in capability subclass 4e, nonirrigated.

506—Moento-Detra-Jemco complex, 0 to 15 percent slopes

Map Unit Description

This map unit is a complex of moderately deep to deep, well drained soils on mesas, hills, and in drainageways. The elevation is 7,900 to 8,300 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is 41 to 45 degrees F., and the average frost-free period is 80 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 35 percent Moento loam, 30 percent Detra loam, 20 percent Jemco silt loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Moento loam

The Moento soil is moderately deep. It formed in alluvium and slope alluvium derived dominantly from sandstone. Typically, the surface layer is dark brown loam about 2 inches thick. The next layer is dark brown clay loam about 4 inches thick. The upper 15 inches of the subsoil are brown clay loam, and the lower 9 inches are strong

brown sandy clay loam. The substratum is reddish yellow sandy clay loam about 6 inches thick. Fractured sandstone bedrock is at a depth of 36 inches; however, the depth to bedrock generally ranges from 20 to 40 inches.

The permeability of the Moento soil is moderately slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is moderate.

Detra loam

The Detra soil is deep. It formed in eolian material and slope alluvium over residuum derived from sandstone and shale. Typically, the surface layer is dark brown loam about 16 inches thick. The upper 14 inches of the subsoil are brown loam; the middle part of the subsoil is light reddish brown clay loam about 13 inches thick; and the lower 8 inches are reddish brown clay loam. The substratum is yellowish red sandy clay loam about 6 inches thick. Sandy shale bedrock, weathered in the upper inch, is at a depth of 57 inches; however, the depth to bedrock generally ranges from 40 to 60 inches.

The permeability of the Detra soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 40 to 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low. In many places the topsoil has accumulated in clumps of brush making the topsoil thicker and giving the landform a hummocky surface.

Jemco silt loam

The Jemco soil is moderately deep. It formed in eolian material over residuum derived dominantly from sandstone. Typically the surface is brown silt loam about 7 inches thick. The subsurface layer is light reddish brown loam 7 inches thick. The upper 8 inches of the subsoil are brown loam; the next part is reddish brown clay loam 13 inches thick; and the lower part of the subsoil consists of yellowish red clay loam about 4 inches thick. Hard fractured sandstone bedrock is at a depth of 39 inches; however, the depth to bedrock generally ranges from 20 to 40 inches. Very few rock fragments are found in this soil.

The permeability of the Jemco soil is moderately slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Shawa loam in drainageways; 5 percent Lonecone loam on mesas; and 5 percent Beje loam on ridges. Shawa soils are very deep, loamy throughout and lack subsoil development. Lonecone soils have dark surface layers, do not have an argillic horizon and are moderately deep over weathered sandstone. Beje soils are shallow over sandstone.

Vegetation

The dominant plant associations are *Quercus gambelii*/*Symphoricarpos oreophilus*-*Amelanchier alnifolia* and *Festuca arizonica*/*Muhlenbergia montana*. Some *Quercus gambelii*/*Festuca thurberi* may also occur. The native vegetation on this unit consists mainly of Gambel oak, common snowberry, Arizona fescue, western wheatgrass, and mountain brome. Other important plants that characterize this unit are needleandthread, Thurber's fescue, Kentucky bluegrass, bottlebrush squirreltail, Saskatoon serviceberry, mule-ears, and shrubby cinquefoil. There are also small patches of ponderosa pine and quaking aspen. The average annual production of air-dry vegetation is about 1,500 pounds per acre on the Moento soil, about 1,600 pounds per acre on the Detra soil, and about 1,700 pounds per acre on the Jemco soil.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

This unit is well suited to the building of unsurfaced roads. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of range vegetation. More uniform use of rangeland is aided by properly locating salt and by herding. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture is adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

This map unit is well suited to recreational development on the lower slopes. The main limitation is the presence of slopes that are over 8 percent. Paths and trails can be developed.

This map unit is in capability subclass 4e, nonirrigated.

508—Herm-Pagoda complex, 0 to 15 percent slopes**Map Unit Description**

This map unit is a complex of very deep, well drained soils on mesas and hills. The elevation is 7,800 to 8,200 feet. The average annual precipitation is 16 to 20 inches and the average annual air temperature is 40 to 44 degrees F. The frost-free period is 85 to 100 days. The soil moisture and temperature regimes are ustic and frigid, respectively.

The unit consists of 50 percent Herm loam, 35 percent Pagoda loam, and 15 percent included soils. The components of this map unit are so intricately intermingled that it was not practical to separate them at the scale used.

Brief Soil Description**Herm loam**

The Herm soil formed in slope alluvium derived dominantly from shale and sandstone. The surface layer is dark grayish brown loam about 6 inches thick. The next layer is dark brown clay loam about 7 inches thick. The upper 4 inches of subsoil are grayish brown clay loam; the next part is brown clay loam about 28 inches thick; and the lower part of the subsoil is grayish brown clay loam to a depth of 60 inches or more.

The permeability of the Herm soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Pagoda loam

The Pagoda soil formed in slope alluvium derived dominantly from shale. Typically the organic litter layer is about 1 inch thick and consists mostly of pine needles. The surface is dark grayish brown loam about 4 inches thick. The subsoil is brown clay loam about 16 inches thick. The upper part of the underlying material is grayish brown

clay loam about 11 inches thick; the lower part is light brownish gray clay loam that extends to 61 inches or more.

The permeability of the Pagoda soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high and the hazard of water erosion is moderate. The potential of shrink-swell is high.

This soil typically is found adjacent to grassland parks, but with a moderate to dense stand of trees. The indication is that these soils used to support a thick grass cover and the trees have invaded the site.

Contrasting Inclusions

There are 10 percent inclusions of soils that do not have an argillic horizon. These usually are moderately deep and have fine-loamy or loamy-skeletal soil profiles. They are intermixed throughout the unit or located on the infrequent small ridgetops. Also included are small areas of Nortez soils with sandstone bedrock between depths of 20 and 40 inches. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Pinus ponderosa/Quercus gambelii* and *Pinus ponderosa/Festuca arizonica*. The native vegetation consists mainly of ponderosa pine, Gambel oak, Arizona fescue, western wheatgrass, and prairie Junegrass. Other important plants that characterize this unit are mountain muhly, mountain brome, nodding brome, pine dropseed, elk sedge, bluegrass, bottlebrush squirreltail, mule-ears, common snowberry, Saskatoon serviceberry, and true mountain mahogany. The average annual understory production of air-dry vegetation is about 1,300 pounds per acre on the Herm soil, and about 1,200 pounds per acre on the Pagoda soil.

Soil Management Implications

This map unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 72 on the Herm soil. It can produce about 58 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 60 years old.

The mass movement potential is rated low for this unit because of the slope.

The main concerns in producing and harvesting timber are reforestation and road construction. Planting nursery stock will hasten reforestation. Trees that are suitable for planting are ponderosa pine.

This unit typically has some very uniform-age stands of pine. Production is high and there are few restrictions to harvesting because of the gentle slopes. The gentle slopes however, allow the water from snowmelt to stay on site and saturate the soils late into the spring. Due in part to a lack of existing oak competition, the reforestation potential is expected to be high. Existing reproduction is currently low but this is attributed to the dense tree stands and the thick grass cover.

The main limitations to building unsurfaced roads are the high shrink-swell potential and the low strength of both soils. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve understory vegetation. Stock water development and fencing will help to improve livestock distribution and the growth of vegetation for grazing. If the understory vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

This map unit is well suited to recreational development. The main limitations are the slow permeability and slopes that are over 8 percent. Paths and trails can be developed.

This map unit is in capability subclass 4e, nonirrigated.

509—Burnson loam, dry, 1 to 15 percent slopes

Map Unit Description

This deep, well drained soil is on mesas and hills. The elevation is 7,400 to 7,800 feet. The average annual precipitation is 17 to 19 inches and the average annual air temperature is 43 to 45 degrees F. The frost-free period is 70 to 100 days. The soil moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Burnson loam, dry

The Burnson soil formed in slope alluvium over residuum derived from sandstone and with some influence from eolian material. Typically, the surface is covered with organic litter about 1 inch thick that comes primarily from pine trees. The surface layer is brown loam about 3 inches thick. The next layer is brown clay loam about 4 inches thick. The upper 10 inches of the subsoil are reddish brown sandy clay; and the lower 11 inches are mixed colors of reddish brown and reddish gray sandy clay. The next layer is mixed materials of reddish brown clay and brownish yellow sandy clay loam about 15 inches thick. Hard sandstone bedrock is at a depth of 44 inches; however, the depth to bedrock generally ranges from 40 to 60 inches from the mineral soil surface.

The permeability of the Burnson soil is slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 40 to 60 inches. Runoff is very high and the hazard of water erosion is slight. The potential of shrink-swell is high. Wind erosion can be a problem on this soil where vegetation is sparse.

This soil is on drier sites, and in many places pinyon and juniper are part of the plant composition. Surface deposition and thickness of eolian material may vary from 0 to 8 inches.

Contrasting Inclusions

There are about 5 percent inclusions of soils that are less well developed, have less clay in the subsoil, and in places have more influence from eolian materials, 5 percent Fivepine flaggy loam on ridges, 5 percent Rock outcrop, and 5 percent Herm loam in depressions. Herm soils have dark surface layers more than 10 inches thick. Fivepine soils have bedrock at depths of less than 20 inches. Included areas make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. Some *Quercus gambelii/Symphoricarpos oreophilus-Amelanchier alnifolia* occurs in areas that do not have trees. The native vegetation consists mainly of ponderosa pine, Gambel oak, common snowberry, Arizona fescue, and mountain brome. Other plants that characterize this unit are bluegrass, needlegrass, western wheatgrass, big sagebrush, and antelope bitterbrush. Twoneedle pinyon and Rocky Mountain juniper occur in some places as part of the tree canopy. The average annual understory production of air-dry vegetation is about 900 pounds per acre.

Soil Management Implications

This unit is used for limited timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 60 on the Burnson, dry soil. It can produce about 46 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the slope.

This unit is a transition between cool, somewhat moist sites and dry, warm sites. Timber harvesting of ponderosa pine has promoted drying of the sites thus increasing competition by other trees and shrubs. Therefore, reestablishment of ponderosa pine will be difficult due to periodic droughty seasons especially on those soils with thick eolian surfaces. The soils have clay textures relatively close to the surface where the surface layer is thin. Disturbing the soil and mixing the clay with surface horizon will further decrease the reforestation potential. Some of the lower elevation areas of this unit that had a higher percent of pinyon and juniper trees have been chained in an attempt to increase forage production.

The main limitations to reforestation on these soils are limited rainfall, the high clay content, and plant competition. Competing vegetation can be controlled by properly preparing the site and by spraying or cutting unwanted weeds or brush. Brushy plants such as Gambel oak and snowberry limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Conventional methods of harvesting timber generally can be used. Trees suitable for planting are ponderosa pine.

The main limitations to the building of unsurfaced roads on this unit are the underlying fine-textured subsoil and the high shrink-swell potential. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of range and understory vegetation. If the condition of the range or understory deteriorates, Gambel oak increases. Areas where brush is managed by prescribed burning, chemical or mechanical methods may be subject to a greater hazard of erosion. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the slow permeability and slopes that are over 8 percent. Paths and trails can be developed.

This map unit is in capability subclass 4e, nonirrigated.

510—Jemco-Moento complex, 0 to 15 percent slopes**Map Unit Description**

This map unit is a complex of moderately deep, well drained soils on mesas, hills, and in drainageways. The elevation is 8,000 to 8,500 feet. The average annual precipitation is 18 to 22 inches and the average annual air temperature is 40 to 46

degrees F. The frost-free period is 80 to 100 days. The soil moisture and temperature regimes are ustic and frigid, respectively.

The unit consists of 60 percent Jemco loam, 25 percent Moento loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Jemco loam

The Jemco soil formed in eolian material over residuum derived dominantly from sandstone. Typically the surface layer is brown loam about 7 inches thick. The next layer is light reddish brown loam 7 inches thick. The upper 8 inches of subsoil are brown loam. The next part of the subsoil is reddish brown clay loam 13 inches thick. The lower part of the subsoil is yellowish red clay loam about 4 inches thick. Hard fractured sandstone bedrock is at a depth of 39 inches; however, the depth to bedrock generally ranges from 20 to 40 inches.

The permeability of the Jemco soil is moderately slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Moento loam

The Moento soil formed in alluvium and slope alluvium derived mostly from sandstone. Typically the upper part of the surface layer is dark brown loam about 2 inches thick, and the lower part is dark brown clay loam about 4 inches thick. The upper 15 inches of subsoil are brown clay loam; the lower 9 inches of the subsoil are strong brown sandy clay loam. The substratum is reddish yellow sandy clay loam about 6 inches thick. Hard fractured sandstone bedrock is at a depth of 36 inches; however, the depth to bedrock generally ranges from 20 to 40 inches.

The permeability of the Moento soil is moderately slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included are about 5 percent soils that have thick dark surface horizons, and 10 percent soils more than 40 inches deep over bedrock. Both of these inclusions are in drainageways. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Populus tremuloides/Symphoricarpos oreophilus* in drainageways and on some north slopes and *Pinus ponderosa/Quercus gambelii* on ridges. The native vegetation consists mainly of quaking aspen, ponderosa pine, Gambel oak, common snowberry, Arizona fescue, western wheatgrass, and prairie Junegrass. Other important plants that characterize this unit are Kentucky bluegrass, needleandthread, mountain brome, mountain muhly, sedge, bottlebrush squirreltail Saskatoon serviceberry, Woods' rose, and Oregongrape. The average annual understory production of air-dry vegetation is about 900 pounds per acre on the Jemco soil, and about 1,300 pounds per acre on the Moento soil.

Soil Management Implications

This map unit is used for woodland, livestock grazing, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 74 on the Jemco soil. It can produce about 60 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the slope.

This unit has rather continuous stands of aspen, especially in swales. Because of added moisture effectiveness, either due to north slopes or accumulated water in drainages and swales, the aspen has outcompeted most other shrub and tree species. This unit would provide good big game wildlife habitat and is rated fair to good for forage production. Most aspen areas of this map unit are excellent for firewood gathering. Some of the ridges have thin stands of ponderosa pine but most have little potential for merchantable timber production.

The main limitation for building unsurfaced roads on this unit is the depth to bedrock in both soils.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of range and understory vegetation. If the range or understory vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture is adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

This map unit is well suited to recreational development. The main limitation is the presence of slopes that are over 8 percent. Paths and trails can be developed.

This map unit is in capability subclass 4e, nonirrigated.

511—Granath-Fughes complex, 0 to 15 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mesas, hills, and in drainageways. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 15 to 22 inches, the average annual air temperature is 40 to 45 degrees F., and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 50 percent Granath loam, 35 percent Fughes loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Granath loam

The Granath soil formed in eolian material derived from sandstone. Typically, the surface layer is brown loam about 2 inches thick. The upper part of the subsoil is brown loam about 13 inches thick. The next part is reddish brown loam about 5 inches thick. The lower part of the subsoil is reddish brown clay loam that extends to 60 inches or more.

The permeability of the Granath soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight to moderate. The potential of shrink-swell is low.

Fughes loam

The Fughes soil formed in alluvium and slope alluvium derived from sandstone and shale. Typically, the surface has an organic layer of needles and leaves about 1 inch thick. The surface layer is dark brown loam about 7 inches thick. The upper 19

inches of the subsoil are brown clay loam, and the lower 18 inches are brown clay. The substratum is strong brown clay to a depth of 61 inches or more.

The permeability of the Fughes soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 5 percent Ormiston loam on hills; 5 percent Fivepine flaggy loam on hills and ridges; and 5 percent Nortez loam on hills. Ormiston soils have more than 35 percent rock fragments in the profile. Fivepine soils are shallow over sandstone. Nortez soils are moderately deep. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. Some *Muhlenbergia montana/Festuca arizonica* may also occur in depressional areas. The native vegetation consists mainly of ponderosa pine, Gambel oak, prairie Junegrass, western wheatgrass, mountain brome, mountain muhly, bluegrass, common snowberry, Utah serviceberry, big sagebrush, and Woods' rose. The average annual understory production of air-dry vegetation is about 1,300 pounds on both soils.

Soil Management Implications

This unit is used for timber production, livestock grazing, wildlife recreation.

A representative site index for this map unit for ponderosa pine is 77 on the Granath soil. It can produce about 64 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old. The average canopy cover ranges from 50 to 70 percent for the overstory and 40 to 60 percent for the understory.

The mass movement potential is rated low for this unit because of the slope.

Timber productivity is estimated to be high. The main concerns in producing and harvesting timber are reforestation (*Fig. 12*). Conventional methods of harvesting timber generally can be used. Thinning the overstory generally enhances reproduction and promotes the growth of grass and younger trees.

If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Competing vegetation can be controlled by properly preparing the site and by spraying or cutting to eliminate unwanted weeds, brush, or trees. Planting nursery stock will hasten reforestation. Among the trees suitable for planting is ponderosa pine.

The main limitation to the building of unsurfaced roads on this unit is the low strength. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. More uniform distribution of grazing is aided by properly locating stock water development and salt, and by fencing and herding. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing. Grazing in logged areas should be delayed for at least two years to allow plants to become established.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from



Figure 12.—Plant competition by Gambel oak under this stand of ponderosa pine on Granath-Fughes complex, 0 to 15 percent slopes, can interfere with the reestablishment of trees.

overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

This map unit is well suited to recreational development. If this unit is used for recreational development, the main limitations are the slopes that are over 8 percent and the slow permeability of the Fughes soil. Paths and trails can be developed.

This map unit is in capability subclass 4e, nonirrigated and irrigated.

512—Wetherill loam, 3 to 6 percent slopes

Map Unit Description

This very deep, well drained soil is on mesas. The elevation is 7,000 to 7,400 feet. The average annual precipitation is 13 to 15 inches. The average annual air temperature is about 47 to 50 degrees F, and the frost-free season is 100 to 120 days. The moisture regime is aridic-ustic and the temperature regime is mesic.

Brief Soil Description

Wetherill loam

The Wetherill soil formed in eolian material derived from sandstone. Typically, the surface layer is reddish brown loam about 6 inches thick. The upper part of the subsoil is yellowish red clay loam about 14 inches thick; the lower part is yellowish red loam about 27 inches thick. The substratum is yellowish red loam to a depth of 60 inches or more.

The permeability of the Wetherill soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 10 percent Pulpit loam on hills and 5 percent Lazear soils on the edges of mesas. Pulpit soils have bedrock at 20 to 40 inches. Lazear soils have bedrock at less than 20 inches. Inclusions make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Artemisia tridentata/Elytrigia smithii*. The native vegetation on this unit is mainly western wheatgrass, muttongrass, big sagebrush, and bottlebrush squirreltail. Other common plants that characterize this unit are needleandthread and Indian ricegrass. The average annual production of air-dry vegetation is about 1,200 pounds per acre.

Soil Management Implications

Most areas of this unit are used for livestock grazing, wildlife habitat, and recreation.

The mass movement potential is rated low for this unit because of the slope.

Use of planned grazing systems helps to maintain the quality and quantity of desirable vegetation and reduces erosion. More uniform distribution of livestock is aided by properly locating stock water development and salt, and by fencing and herding. If the condition of the range deteriorates, twoneedle pinyon, Utah juniper and woody shrubs increase. Removal of big sagebrush increases the production of understory forage. Range seeding should be done in conjunction with removal of the big sagebrush. The main limitation for seeding is the limited precipitation. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribing burning or by chemical or mechanical methods may be subject to a greater hazard of erosion.

Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover.

If this map unit is used for recreational development, the main limitation is the dusty conditions that develop with intensive use. Maintaining vegetative cover helps in overcoming the dusty condition of the soil and enhances the beauty of the area.

This map unit is in capability subclass 3e, nonirrigated and irrigated.

513—Maudrey-Tombac complex, 0 to 15 percent slopes**Map Unit Description**

This map unit is a complex of very deep, well drained soils on mesas. The elevation is 8,200 to 8,900 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 40 to 42 degrees F., and the average frost-free period is 70 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 50 percent Maudrey loam, 35 percent Tombac loam, 10 percent similar soils, and 5 percent dissimilar included soils. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include Fughes loam on mesas. These similar soils make up about 10 percent of the total acreage; the percentage varies from one area to another.

The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Maudrey loam

The Maudrey soil formed in slope alluvium derived from sandstone. Typically, the upper part of the surface layer is dark brown loam about 4 inches thick. The next part is brown loam about 15 inches thick. The subsurface layers are yellowish brown and very pale brown loam about 12 inches thick. The upper 10 inches of the subsoil are strong brown clay loam; the lower 13 inches are strong brown clay. The substratum is yellowish brown clay to a depth of 60 inches or more. The similar Fughes soils have argillic horizons with their upper boundary above 24 inches.

The permeability of the Maudrey soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low in the upper part of the profile and high in the lower part.

Tombac loam

The Tombac soil formed in slope alluvium over residuum derived from sandstone and shale. Typically, the surface is covered with a mat of intermediately decomposed needles and twigs about 1 inch thick. The surface layer is very dark grayish brown loam about 11 inches thick. The next layer is pale brown loam and brown clay loam about 4 inches thick. The upper part of the subsoil is strong brown clay about 10 inches thick; the lower part is reddish yellow clay about 11 inches thick. The substratum is light gray clay to a depth of 61 inches or more.

The permeability of the Tombac soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit is about 5 percent Granath soils on mesas. Granath soils have less clay in the subsoil.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation on this unit consists of ponderosa pine, quaking aspen, Gambel oak, mountain snowberry, mountain brome, nodding brome, and prairie Junegrass. Other common plants that characterize this unit are Parry's danthonia, needleandthread, elk sedge, western wheatgrass, cinquefoil, Kentucky bluegrass, Saskatoon serviceberry, and bottlebrush squirreltail. The average annual understory production of air-dry vegetation is about 1,500 pounds per acre on the Maudrey soil, and about 1,100 pounds per acre on the Tombac soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 75 on the Maudrey soil. It can produce about 62 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the slope.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed.

Timber productivity is estimated to be moderate. Conventional methods of harvesting timber generally can be used, but their use may be limited when the soil is wet to limit compaction and rutting. Thinning dense stands of younger trees for use as poles increases the growth rate of the rest of the stand and increases the understory vegetation.

This unit is well suited to the production of ponderosa pine. The main limitation to reforestation on this unit is plant competition from aspen and Gambel oak. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Spraying, cutting, or girdling to eliminate unwanted weeds, brush, or trees can control competing vegetation. Planting nursery stock will hasten reforestation. Grazing in harvested areas should be deferred for at least 2 years to ensure development of sufficient plant cover to protect the soil from erosion.

This unit is located at the uppermost elevations for ponderosa pine (transition into aspen and mixed conifer types). If ponderosa pine is planted, the plantation is highly subject to snow damage.

The main limitations to the building of unsurfaced roads on this unit are the clayey texture and low strength of the Tombac soil, and the high shrink-swell potential in part of the Maudrey soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and forage quality. Loss of the surface layer results in a severe decrease in productivity and in the potential of the unit to produce plants suitable for grazing. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the slow permeability and slopes that are over 8 percent. Paths and trails can be developed. Drainage should be provided for paths and trails.

This map unit is in capability subclass 4e, nonirrigated.

525—Arabrab loam, 0 to 15 percent slopes

Map Unit Description

This shallow, well drained soil is on mesas, hills and ridges. The elevation is 6,600 to 7,200 feet. The average annual precipitation is 13 to 15 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 110 to 125 days. The moisture regime is aridic-ustic and the temperature regime is mesic.

Brief Soil Description

Arabrab loam

The Arabrab soil formed in residuum and reworked eolian material derived dominantly from sandstone. Typically, the surface layer is brown loam about 3 inches thick. The subsoil is brown clay loam about 4 inches thick. The next layer is pinkish gray cobbly loam about 8 inches thick over hard sandstone. The depth to bedrock ranges from 10 to 20 inches.

The permeability of the Arabrab soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Brumley loam in drainageways; 5 percent soils that have more than 35 percent rock fragments in the profile on ridges; and 5 percent soils that are deep and have a dark surface layer on mesas. Brumley soils are very deep. Included soils make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus edulis-Juniperus osteosperma/Cercocarpus montanus*. Some *Pinus edulis-Juniperus osteosperma/Oryzopsis hymenoides* may also occur on similar landscapes. The native vegetation consists mainly of twoneedle pinyon, Utah juniper, and mountain muhly. Other common native plants include western wheatgrass, Indian ricegrass, blue grama, bottlebrush squirreltail, antelope bitterbrush, Gambel oak, and mountain mahogany. The average annual production of air-dry vegetation is about 600 pounds per acre.

Soil Management Implications

This map unit is used for livestock grazing and wildlife habitat.

A representative site index for this map unit for twoneedle pinyon is 40 on the Arabrab soil. It can produce about 3.3 cubic feet of timber per acre per year from a fully stocked stand of even-aged trees 90 years old.

The mass movement potential is rated low for this unit because of the slope.

The main limitation to the building of unsurfaced roads on the Arabrab loam is the depth to bedrock.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and vegetation for grazing. More uniform use of rangeland is aided by properly locating salt and by herding.

Removal of pinyon and juniper increases the production of understory forage. Range seeding should be done in conjunction with removal of the overstory. Seeding late in the fall will help ensure that soil moisture will be available in the spring for seed germination.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the depth to bedrock and the dusty conditions that may develop with intensive use. Maintaining vegetative cover helps in overcoming the dusty condition and enhances the beauty of the area. Paths and trails can be developed.

This map unit is in capability subclass 6s, nonirrigated.

526—Lonecone loam, 0 to 5 percent slopes

Map Unit Description

This moderately deep, well drained soil is on mesas. The elevation is 7,600 to 8,500 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is 40 to 44 degrees F., and the average frost-free period is 80 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Lonecone loam

The Lonecone soil formed in residuum derived from sandstone and shale and has some eolian influence. Typically, the surface layer is dark brown loam about 6 inches thick. The upper 21 inches of the underlying layer are dark brown loam, and the lower 3 inches are strong brown gravelly sandy clay loam. Soft, partially weathered sandstone is at a depth of 30 inches. The depth to bedrock ranges from 20 to 40 inches.

The permeability of the Lonecone soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 20 to 40 inches. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 15 percent soils that are less than 20 inches to bedrock and small areas that are deeper than 40 inches to bedrock, both occurring on mesas. Included areas make up about 20 percent of the map unit.

Vegetation

The dominant plant association is *Artemisia tridentata/Elytrigia smithii*. The native vegetation on this unit consists mainly of Arizona fescue, western wheatgrass, Kentucky bluegrass, mountain brome, big sagebrush, Utah serviceberry, mountain snowberry and Gambel oak. The average annual production of air-dry vegetation is about 1,500 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

This soil is well suited to the building of unsurfaced roads.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and range production. More uniform use of rangeland is aided by properly locating salt and by herding. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

This unit is well suited to recreational development.

This map unit is in capability subclass 4c, nonirrigated.

527—Ormiston-Beje complex, 5 to 30 percent slopes

Map Unit Description

This map unit is a complex of deep to shallow, well drained soils on mesas, hills, and ridges. This map unit has about 1 to 3 percent stones on the surface. The elevation is 7,100 to 7,800 feet. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 44 to 45 degrees F, and the average frost-free period is 80 to 110 days. The moisture and temperature regimes are ustic and frigid, respectively.

This unit consists of 50 percent Ormiston loam, 35 percent Beje loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Ormiston loam

The Ormiston soil is deep. It formed in slope alluvium and eolian material derived dominantly from sandstone. Typically, the surface layer is brown loam about 7 inches thick with 1 to 3 percent stones on the surface. The upper part of the subsoil is reddish brown very stony clay loam about 17 inches thick; the lower part is reddish brown stony clay about 8 inches thick. The substratum is pinkish white stony clay loam about 12 inches thick. Sandstone bedrock is at a depth of 44 inches; however, the depth to bedrock generally ranges from 40 to 60 inches or more.

The permeability of the Ormiston soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Beje loam

The Beje soil is shallow. It formed in slope alluvium and residuum derived dominantly from sandstone. Typically, the surface layer is brown loam 6 inches thick. The subsoil is brown clay loam 8 inches thick over hard fractured sandstone. The depth to fractured bedrock ranges from 10 to 20 inches.

The permeability of the Beje soil is moderately slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 3 percent Fivepine, 3 percent Nortez, 3 percent Granath, 3 percent Fughes, and 3 percent Rock outcrop, all on mesas and hills. Fivepine soils are shallow and clayey. Fughes and Granath soils are very deep and have less than 35 percent rock fragments. Nortez soils are moderately deep. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus edulis-Juniperus osteosperma/Cercocarpus montanus*. Some *Pinus ponderosa/Quercus gambelii* may also occur on north slopes and in more moist sites. The native vegetation on this unit consists mainly of twoneedle pinyon, Rocky Mountain juniper, true mountain mahogany, and blue grama. Other important plants that characterize this unit are Kentucky bluegrass, mountain brome, western wheatgrass, needlegrass, muttongrass, prairie Junegrass, mountain muhly, Utah serviceberry, Gambel oak, and black sagebrush. The average annual understory production of air-dry vegetation is about 1,000 pounds per acre on the Ormiston soil, and about 900 pounds per acre on the Beje soil.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

A representative site index for this map unit for pinyon pine is 50 on the Ormiston soil. It can produce about 4.6 cubic feet of timber per acre per year from a fully stocked stand of even-aged trees 90 years old. Other trees suited to this soil are Ponderosa pine.

The mass movement potential is rated low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the depth to bedrock and the content of large stones. To stabilize grades, road cuts, road fills, and other disturbed areas water bars can be constructed and the areas reseeded.

Removal of pinyon and juniper increases the production of understory forage. Range seeding should be done in conjunction with removal of the overstory. Careful management is needed to prevent excessive grazing on this unit because it is difficult to revegetate. More uniform distribution of grazing is aided by properly locating stock water and salt, and by fencing and herding. If the range vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the depth to bedrock and the content of large stones. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the stones on the surface, the depth to bedrock in the Beje soil, and slopes that are over 8 percent. Paths and trails can be developed. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Ormiston soil is in capability subclass 6e, nonirrigated. The Beje soil is in capability subclass 6s, nonirrigated.

552—Burnson loam, 1 to 15 percent slopes

Map Unit Description

This deep, well drained soil is on mesas. The elevation is 7,400 to 8,200 feet. The average annual precipitation is 20 to 23 inches and the average annual air temperature is 41 to 45 degrees F. The frost-free period is 70 to 100 days. The soil moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Burnson loam

The Burnson soil formed in slope alluvium over residuum derived mostly from sandstone and shale, but has some influence from eolian material. Typically, the surface is covered with an organic litter layer about 1 inch thick and comes primarily from pine trees. The surface layer is brown loam about 3 inches thick. The next layer is brown clay loam about 4 inches thick. The upper 10 inches of the subsoil are reddish brown sandy clay; the lower 11 inches are mixed colors of reddish brown and reddish gray sandy clay. The next layer consists of mixed materials of reddish brown clay and brownish yellow sandy clay loam about 15 inches thick. Hard sandstone bedrock is at a depth of 44 inches; however, the depth to bedrock generally ranges from 40 to 60 inches from the mineral soil surface.

The permeability of the Burnson soil is slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 40 to 60 inches. Runoff is very high and the hazard of water erosion is slight. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this map unit is 5 percent Detra loam in small drainageways; about 5 percent Herm soils in depressions; and 10 percent Fivepine flaggy loam on breaks of hills, small ridgetops, or on gentle slopes where sandstone bedrock is near the

surface. Detra soils are fine-loamy and have thick dark surface layers. Herm soils are very deep and have dark surface layers.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation consists mainly of ponderosa pine, Gambel oak, common snowberry, and Arizona fescue. Other plants that characterize this unit are mountain brome, bluegrass, western wheatgrass, needlegrass, big sagebrush, antelope bitterbrush, and Rocky Mountain juniper. Scattered aspen patches occur in some drainageways and on north slopes. The average annual understory production of air-dry vegetation is about 900 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

A representative site index for this map unit for ponderosa pine is 80 on the Burnson soil. It can produce about 69 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 40 years old. Canopy cover is estimated at 25 to 55 percent forest crown density and 10 to 30 percent shrub crown density.

This map unit will have some restrictions to management activities due to thin surface horizons over clay. The site productivity could be reduced with exposure of the clayey subsoil, or operating equipment while the soils are still wet from snowmelt or summer rains.

This map unit is well suited to the production of ponderosa pine. The main limitations to reforestation on this soil are the high clay content and the plant competition. Competing vegetation can be controlled by properly preparing the site and by spraying or cutting unwanted weeds or brush. Brushy plants such as Gambel oak and snowberry limit but do not prevent natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Trees that are suitable for planting are ponderosa pine. Conventional methods of harvesting timber generally can be used.

The main limitations to the building of unsurfaced roads on this unit are the clayey subsoil and the high shrink-swell potential. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Excessive disturbance or removal of the surface soil may expose the fine textured subsoil. Because clay textures are so near the surface compaction and rutting are critical management concerns.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of understory vegetation. If the condition of the range or understory deteriorates, Gambel oak increases. In areas where brush is managed by prescribed burning, chemical or mechanical methods, the soil may be subject to a greater hazard of erosion. If the range or understory vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

This map unit is well suited to recreational development. The main limitations are the slow permeability and the presence of slopes that are over 8 percent. Paths and trails can be developed.

This map unit is in capability subclass 4e, nonirrigated.

553—Burnson-Herm complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of deep and very deep, well-drained soils on hills and structural benches. The elevation is 7,800 to 9,000 feet. The average annual precipitation is 20 to 23 inches and the average annual air temperature is 41 to 45 degrees F., and the average frost-free period is 70 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 50 percent Burnson clay loam, 30 percent Herm loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Burnson clay loam

The Burnson soil is deep. It formed in slope alluvium over residuum derived dominantly from sandstone with some influence from eolian material. Typically, the surface is covered with a mat of decomposing organic litter about 1 inch thick. The surface layer is brown clay loam about 3 inches thick. The next layer is brown clay loam about 4 inches thick. The upper 10 inches of the subsoil are reddish brown sandy clay, and the lower 11 inches are mixed colors of reddish brown and reddish gray sandy clay. The next layer consists of mixed materials of reddish brown clay and brownish yellow sandy clay loam about 15 inches thick. Hard sandstone bedrock is at a depth of 44 inches; however, the depth to bedrock generally ranges from 40 to 60 inches from the mineral soil surface.

The permeability of the Burnson soil is slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 40 to 60 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Herm loam

The Herm soil is very deep. It formed in slope alluvium derived dominantly from shale and sandstone. Typically, the surface layer is dark grayish brown loam about 6 inches thick. The upper part of the subsoil is dark brown clay loam about 7 inches thick. The next part is grayish brown clay loam about 4 inches thick. The lower part of the subsoil is brown clay loam about 28 inches thick. The underlying material is grayish brown clay loam to a depth of 60 inches or more.

The permeability of the Herm soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 5 percent Jemco silt loam on ridges; 10 percent Hesperus loam in drainageways; and 5 percent Beje loam on hills and breaks to drainageways. Jemco soils are moderately deep. Hesperus soils are very deep and have fine-loamy subsoils. Beje soils are shallow over sandstone.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation on this unit consists mainly of ponderosa pine, Gambel oak, common snowberry, and Arizona fescue. Other important plants that characterize this unit are mountain brome, Saskatoon serviceberry, antelope bitterbrush, big sagebrush, true mountain mahogany, bottlebrush squirreltail, needlegrass, prairie Junegrass, bluegrass, mountain muhly, elk sedge, western wheatgrass, and Rocky Mountain juniper. The average annual understory production of air-dry vegetation is about 900 pounds per acre on the Burnson soil, and about 1,300 pounds per acre on the Herm soil.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for ponderosa pine is 80 on the Burnson soil. It can produce about 69 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 40 years old.

The mass movement potential is rated low for this unit.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitations to reforestation on these soils are the high clay content and plant competition. Competing vegetation can be controlled by properly preparing the site and by spraying, cutting or girdling to eliminate unwanted weeds, brush or trees. Brushy plants such as Gambel oak and snowberry limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Trees that are suitable for planting are ponderosa pine.

The main limitations to the building of unsurfaced roads on this unit are the underlying fine-textured subsoils and the high shrink-swell potential. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of understory vegetation. If the condition of the range or understory deteriorates, Gambel oak increases. In areas where brush is managed by prescribed burning, chemical or mechanical methods, the soil may be subject to a greater hazard of erosion. If areas are reseeded, slope may restrict the methods of reseeding. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the slope and the slow permeability. The slope limits the areas mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

571—Mancos-Skisams-Skutum complex, 1 to 15 percent slopes

Map Unit Description

This map unit is a complex of very shallow to very deep, well drained soils on structural benches and mesas. The elevation is 8,500 to 9,600 feet. The average annual precipitation is 25 to 30 inches, the average annual air temperature is 36 to 42 degrees F., and the average frost-free period is 50 to 80 days. The moisture and temperature regimes are ustic and cryic, respectively for the Skisams soil and ustic-udic and cryic for the Mancos and Skutum soils, respectively.

This map unit consists of 40 percent Mancos loam, 35 percent Skisams loam, and 20 percent Skutum loam and similar soils. There are some soils in the map unit that are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include a soil similar to Mancos only with a thinner dark surface. Similar inclusions make up about 2 percent of the unit; the percentage varies from one area to another. Dissimilar included soils make up about 3 percent of the unit. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Mancos loam

The Mancos soil is moderately deep. It formed in slope alluvium derived dominantly from shale and sandstone. Typically, the surface layer is dark grayish brown loam about 8 inches thick. The next layer is dark grayish brown clay loam about 7 inches thick. The upper 6 inches of the subsoil are dark grayish brown clay loam; the middle 5 inches are brown clay loam; and the lower 8 inches of the subsoil are pale brown gravelly sandy clay loam. Hard shale bedrock is at a depth of 34 inches; however, the depth to bedrock generally ranges from 20 to 40 inches.

The permeability of the Mancos soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is high.

Skisams loam

The Skisams soil is shallow or very shallow. It formed in slope alluvium derived dominantly from sandstone and shale. Typically, the surface layer is brown loam about 12 inches thick. Hard sandstone bedrock is at a depth of 12 inches; however, the depth to bedrock generally ranges from 6 to 20 inches.

The permeability of the Skisams soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 6 to 20 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Skutum loam

The Skutum soil formed in slope alluvium derived dominantly from shale and sandstone. Typically, the surface is covered with a mat of organic material consisting of leaves, twigs, and roots about 3 inches thick. The surface layer is grayish brown loam about 5 inches thick. The next layer is grayish brown clay loam about 12 inches thick. The upper part of the subsoil is grayish brown gravelly clay loam about 10 inches thick, and the lower part is brown gravelly clay loam about 17 inches thick. The substratum is light yellowish brown gravelly sandy clay loam to a depth of 53 inches. Shale bedrock is at a depth of 53 inches; however, the depth to bedrock generally ranges from 50 to 60 inches from the mineral soil surface.

The permeability of the Skutum soil is slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 50 or more inches.

Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are small areas of Clayburn loam in drainageways, and small areas of Valto very stony fine sandy loam on hills. Clayburn soils are very deep, have fine-loamy subsoils, and have thick dark surface layers. Valto soils are shallow and have more than 35 percent rock fragments. Included areas make up about 3 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Populus tremuloides*/*Symphoricarpos oreophilus*/*Carex geyeri* in quaking aspen areas. Open parks have *Festuca arizonica*/*Muhlenbergia montana* and *Artemisia cana*/*Elytrigia smithii*. The native vegetation on this unit consists mainly of quaking aspen, common snowberry, Thurber's fescue, and elk sedge. Other important plants that characterize this unit are Parry's danthonia, Arizona fescue, Letterman's needlegrass, Kentucky bluegrass, mountain brome, muttongrass, cinquefoil, Nevada pea, silver sagebrush, and slender wheatgrass. Gambel oak occurs at the lower elevations of this map unit. The average annual production of air-dry vegetation is about 3,000 pounds per acre on the Mancos soil, about 1,000 pounds per acre on the Skisams soil, and about 2,500 pounds per acre on the Skutum soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for quaking aspen is 75 on the Skutum soil. It can produce about 43 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope.

The Mancos soil is poorly suited to the production of aspen and the Skutum soil is moderately well suited to the production of aspen. The main concerns in producing and harvesting timber are reforestation after harvest. Timber productivity is estimated to be moderate on the Skutum soil and low on the Mancos soil. Conventional methods of harvesting timber generally can be used, but their use may be limited when the soil is wet. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

Competing vegetation can be controlled by properly preparing the site and by spraying, cutting, or burning to eliminate unwanted weeds, brush, or trees. Quaking aspen will usually regenerate from roots after harvest.

The main limitations to the building of unsurfaced roads on this unit are the high clay content in the Mancos and Skutum soils and the shallow depth to bedrock in the Skisams soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of range and understory vegetation. If the condition of the range or understory deteriorates, snowberry tends to increase.

Wildlife such as elk, mule deer, bear, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the depth to bedrock in the Skisams soil, the slow permeability, and slopes that are over 8 percent. Paths and trails can be developed.

The Mancos and Skutumpah soils are in capability subclass 6c, nonirrigated. The Skisams soil is in capability subclass 6s, nonirrigated.

572—Sudduth loam, 0 to 15 percent slopes

Map Unit Description

This very deep, moderately well drained soil is in drainageways and depressions on mesas. The elevation is 8,500 to 10,000 feet. The average annual precipitation is 25 to 30 inches, the average annual air temperature is 34 to 40 degrees F., and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Sudduth loam

The Sudduth soils formed in alluvium derived mostly from sandstone and shale of the Dakota and Burro Canyon formations. Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The upper 6 inches of the subsoil are dark grayish brown clay loam, and the lower 9 inches are brown clay. The upper 16 inches of the substratum are light brownish gray gravelly clay loam; the next 14 inches are very dark gray clay; and the lower part consists of black clay to a depth of 60 inches or more.

The permeability of the Sudduth soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. A seasonal high water table is at a depth of 36 to 72 inches from April through June. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 10 percent soils with bedrock at less than 60 inches and 5 percent soils with more than 35 percent rock fragments in the profile, both in depressions. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Festuca thurberi*/*Festuca arizonica*. The native vegetation consists mainly of Thurber's fescue, elk sedge, Kentucky bluegrass, timothy, shrubby cinquefoil, slender cinquefoil, clover, yarrow, and iris. The average annual production of air-dry vegetation is about 2,000 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this soil are a seasonal high water table, the shrink-swell potential, and the clayey soil texture. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition.

Stock water development and fencing will help to improve livestock distribution and forage quality. More uniform use of rangeland is aided by properly locating salt and by herding. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall will help ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

If this unit is used for recreational development, the main limitations are the slow permeability and slopes that are over 8 percent. Paths and trails can be developed.

This map unit is in capability subclass 6c, nonirrigated.

600—Valto-Rock outcrop complex, 10 to 65 percent slopes

Map Unit Description

This map unit is a complex of shallow, well drained soils and Rock outcrop on mountain slopes and ridges. The elevation is 8,200 to 9,600 feet. The average annual precipitation is 20 to 28 inches, the average annual air temperature is 40 to 44 degrees F, and the average frost-free period is 90 to 110 days. The moisture and temperature regimes are ustic and frigid, respectively.

This unit consists of 50 percent Valto very stony fine sandy loam, 35 percent Rock outcrop, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Valto very stony fine sandy loam

The Valto soil formed in residuum derived dominantly from sandstone. Typically, the surface is covered with a mat of decomposing needles, leaves, and twigs about 2 inches thick. The surface layer is dark reddish gray very stony fine sandy loam about 2 inches thick. The subsurface layer is light reddish brown very stony fine sandy loam about 10 inches thick. Fractured sandstone bedrock is at a depth of 14 inches; however, the depth to bedrock generally ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Valto soil is moderately rapid. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of sandstone bedrock usually as cliffs and ledges and as bare rock on structural benches and mountain slopes.

Contrasting Inclusions

Included in this unit are about 5 percent Clayburn loam on toeslopes; 5 percent Fortwingate stony fine sandy loam on structural benches; and 5 percent Needleton stony loam on mountain slopes. Clayburn soils are very deep and have less than 35 percent rock fragments in the profile. Fortwingate soils are moderately deep and have fine textured subsoils. Needleton soils are very deep. Included areas make up about 15 percent of the map unit; the percentage varies from one place to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation on this unit consists mainly of ponderosa pine, Gambel oak, and Arizona

fescue. Other important plants that characterize this unit are mountain brome, mountain muhly, bluegrass, nodding brome, prairie Junegrass, elk sedge, common snowberry, true mountain mahogany, and Saskatoon serviceberry. Rocky Mountain Douglas-fir, white fir, and a few quaking aspen occur at the higher elevations. The average annual understory production of air-dry vegetation is about 500 pounds per acre on the Valto soil.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and limited livestock grazing.

A representative site index for this map unit for ponderosa pine is 65 on the Valto soil. It can produce about 50 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the shallow depth to bedrock.

The main concerns in producing and harvesting timber are shallow soils over hard bedrock that effect construction of logging roads and makes reforestation very difficult. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. Gambel oak can limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Trees suitable for planting are ponderosa pine.

The main limitations to building unsurfaced roads on this unit are the stones in the soil, the shallow depth to bedrock, rock outcrops, and the slope.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, squirrels, turkeys, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover.

If this map unit is used for recreational development, the main limitations are the depth to bedrock, rock outcrops, and steep slopes in some places.

The Valto soil is in capability subclass 7s, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

601—Weminuche loam, 30 to 75 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 8,200 to 9,600 feet. The average annual precipitation is 25 to 32 inches, the average annual air temperature is 35 to 40 degrees F, and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Weminuche loam

The Weminuche soil formed in slope alluvium derived dominantly from red bed sandstone. Typically, the surface is covered with a mat of decomposing leaves and twigs about 2 inches thick. The surface layer is reddish brown loam about 9 inches

thick. The next layer is reddish brown loam and reddish brown clay loam about 10 inches thick. The upper 13 inches of the subsoil are reddish brown clay loam, and the lower 10 inches are red gravelly clay loam. The substratum is red clay loam to a depth of 62 inches or more.

The permeability of the Weminuche soil is moderately slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are small areas of soils with dark colored surface layers on toeslopes; small areas of Scotch loam on breaks and ridges; small areas of Graysill loam and Snowdon stony loam, both on mountain slopes; and Rock outcrop. Scotch and Snowdon soils are shallow. Graysill soils are moderately deep over bedrock. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Abies concolor-Pseudotsuga menziesii/Symphoricarpos oreophilus* and *Abies lasiocarpa-Picea engelmannii/Vaccinium scoparium*. The native vegetation on this unit consists mainly of white fir, Rocky Mountain Douglas-fir, quaking aspen, Englemann's spruce, and subalpine fir. Other important plants that characterize this unit are Thurber's fescue, Arizona fescue, mountain brome, bluegrass, common snowberry, grouse whortleberry, elk sedge, Utah serviceberry, twinberry honeysuckle, and Oregongrape. The average annual understory production of air-dry vegetation is about 700 pounds per acre.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and limited livestock grazing.

A representative site index for this map unit for Englemann's spruce is 80 on the Weminuche soil. It can produce about 76 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated high for this unit because of the steep slopes.

The main concerns in producing and harvesting timber are equipment limitations due to the steep slopes and preventing erosion along roads and other areas where vegetation has been removed. Minimizing the risk of erosion is essential in harvesting timber. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary. Among the trees that are suitable for planting are Englemann's spruce, Rocky Mountain Douglas-fir, white fir, and lodgepole pine.

The main limitation for building unsurfaced roads on this unit is the presence of steep slopes. Careful consideration of road systems and harvesting methods should be made to minimize erosion. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. The slope limits access by livestock and results in overgrazing of the less sloping areas. Livestock grazing should be managed to protect the soil from excessive erosion.

Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitation is the slope, which limits use of the unit mainly to a few paths and trails. The paths and trails should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

602—Weminuche loam, 5 to 30 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes and toeslopes of mountains. The elevation is 8,200 to 9,600 feet. The average annual precipitation is 25 to 32 inches, the average annual air temperature is 35 to 40 degrees F, and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Weminuche loam

The Weminuche soil formed in slope alluvium derived dominantly from red bed sandstone. Typically, the surface is covered with a mat of decomposing leaves and twigs about 2 inches thick. The surface layer is reddish brown loam about 9 inches thick. The next layer is reddish brown loam and reddish brown clay loam about 10 inches thick. The upper 13 inches of the subsoil are reddish brown clay loam, and the lower 10 inches are red gravelly clay loam. The substratum is red clay loam to a depth of 62 inches or more.

The permeability of the Weminuche soil is moderately slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 8 percent Anvik loam on toeslopes and structural benches; about 5 percent Scotch loam on ridges; and small areas of Graysill loam on structural benches. Anvik soils have dark colored surface layers. Scotch soils are shallow. Graysill soils are moderately deep. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Abies concolor*-*Pseudotsuga menziesii*/*Festuca arizonica* and *Abies lasiocarpa*-*Picea engelmannii*/*Vaccinium scoparium*. *Populus tremuloides*/*Symphoricarpos oreophilus* occurs in aspen groves. The native vegetation on this unit consists mainly of white fir, Rocky Mountain Douglas-fir, Englemann's spruce, subalpine fir, and quaking aspen. Other important plants that characterize this unit are Thurber's fescue, Arizona fescue, bluegrass, mountain brome, common snowberry, grouse whortleberry, elk sedge, twinberry honeysuckle, Oregongrape, and Utah serviceberry. The average annual understory production of air-dry vegetation is about 700 pounds per acre.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for Englemann's spruce is 80 on the Weminuche soil. It can produce about 76 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old. Other trees suited to this unit are white fir, Rocky Mountain Douglas-fir, and quaking aspen.

The mass movement potential is rated low for this unit.

The main concerns in producing and harvesting timber are reforestation and preventing erosion along roads and other areas where vegetation has been removed. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce, Rocky Mountain Douglas-fir, white fir, and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of understory plants. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Wildlife such as elk, mule deer, squirrels, coyote, blue grouse, and bear utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover.

If this map unit is used for recreational development, the main limitation is the presence of slopes that are over 8 percent. Lower slopes could be used for camp areas and picnic areas. Steeper slopes are suited mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

603—Weminuche-Anvik complex, 15 to 60 percent slopes**Map Unit Description**

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 8,400 to 9,600 feet. The average annual precipitation is 25 to 32 inches, the average annual air temperature is 35 to 40 degrees F, and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 55 percent Weminuche loam, 25 percent Anvik loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used. Weminuche soils are on the steeper areas and Anvik soils are on less sloping areas.

Brief Soil Description

Weminuche loam

The Weminuche soil formed in slope alluvium derived dominantly from red bed sandstone. Typically, the surface is covered with a mat of decomposing leaves and twigs about 2 inches thick. The surface layer is reddish brown loam about 9 inches thick. The next layer is reddish brown loam and reddish brown clay loam about 10 inches thick. The upper 13 inches of the subsoil are reddish brown clay loam, and the lower 10 inches are red gravelly clay loam. The substratum is red clay loam to a depth of 62 inches or more.

The permeability of the Weminuche soil is moderately slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Anvik loam

The Anvik soil formed in slope alluvium derived dominantly from sandstone and shale. Typically, the surface is covered with a mat of decomposed leaves and twigs about 1 inch thick. The surface layer is dark grayish brown loam about 10 inches thick. The subsurface layer is light yellowish brown loam about 11 inches thick. The upper 9 inches of the subsoil are brown clay loam, and the lower 14 inches are yellowish brown clay loam. The substratum is yellowish brown sandy clay loam to a depth of 61 inches or more.

The permeability of the Anvik soil is moderate. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Clayburn loam on toeslopes and in drainageways; 5 percent Tuckerville loam on mountain slopes; small areas of Scotch loam on ridges and breaks; small areas of Graysill loam on structural benches; and small areas of Snowdon stony loam on mountain slopes. Tuckerville soils have more than 35 percent rock fragments in the profile. Clayburn soils have thick dark colored surface layers. Scotch and Snowdon soils are shallow. Graysill soils are moderately deep. Included areas make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Abies concolor-Pseudotsuga menziesii/Festuca arizonica*, *Abies lasiocarpa-Picea engelmannii/Vaccinium scoparium*, and *Populus tremuloides/Symphoricarpos oreophilus*. The native vegetation on this unit consists mainly of white fir, Rocky Mountain Douglas-fir, quaking aspen, Englemann's spruce, and subalpine fir. Other important plants that characterize this unit are Arizona fescue, Thurber's fescue, bluegrass, mountain brome, nodding brome, elk sedge, common snowberry, spike trisetum, twinberry honeysuckle, Oregon grape, Utah serviceberry, and grouse whortleberry. The average annual understory production of air-dry vegetation is about 700 pounds per acre on the Weminuche soil, and about 1,000 pounds per acre on the Anvik soil.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for Englemann's spruce is 80 on the Weminuche soil. It can produce about 76 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated moderate for this unit.

The main concerns in producing and harvesting timber are equipment limitations on the steeper slopes and preventing erosion along roads and other places where vegetation has been removed. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Planting nursery stock will hasten reforestation. Hand planting is usually necessary because of the slope. Among the trees that are suitable for planting are Englemann's spruce, Rocky Mountain Douglas-fir, white fir, and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest.

The main limitation to building unsurfaced roads on this unit is the presence of steep slopes. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and forested areas are used for livestock grazing. The slopes limit access by livestock and results in overgrazing of the less sloping areas. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, squirrels, coyotes, blue grouse, and bear utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover.

If this map unit is used for recreational development, the main limitation is the presence of steep slopes. These slopes limit the use of the unit mainly to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

605—Nordic very stony sandy loam, 6 to 25 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 8,000 to 10,000 feet. The average annual precipitation is 25 to 35 inches, the average annual air temperature is 38 to 42 degrees F., and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are ustic-udic and cryic, respectively.

Brief Soil Description

Nordic very stony sandy loam

The Nordic soil formed in slope alluvium and colluvium derived dominantly from sandstone. Typically, the surface is covered with a mat of organic material about 1 inch thick. The upper part of the surface layer is dark grayish brown very stony sandy loam about 6 inches thick. The lower part of the surface layer is dark grayish brown very stony loam about 13 inches thick. The subsurface layer is light brown very stony sandy loam about 8 inches thick. The subsoil is brown very stony sandy clay loam about 24 inches thick. The substratum is light yellowish brown extremely stony sandy loam to a depth of 61 inches or more.

The permeability of the Nordicol soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Frisco stony loam on mountain slopes; 5 percent Clayburn loam on toeslopes and in drainageways; small areas of Hourglass loam on structural benches; and small areas of Snowdon stony loam on mountain slopes. Some small areas have large stones on the surface. Frisco soils have light colored surface layers. Clayburn and Hourglass soils have less than 35 percent rock fragments in the profile. Snowdon soils are shallow. Included areas make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies concolor-Pseudotsuga menziesii/Quercus gambelii*. The native vegetation on this unit consists mainly of white fir, Rocky Mountain Douglas-fir, quaking aspen, ponderosa pine, Englemann's spruce, Gambel oak, and Arizona fescue. Other important plants that characterize this unit are bluegrass, mountain brome, Thurber's fescue, elk sedge, mountain muhly, snowberry, Saskatoon serviceberry, and Nevada pea. The average annual understory production of air-dry vegetation is about 2,000 pounds per acre.

Soil Management Implications

Most areas of this unit are used for livestock grazing and wildlife habitat. A few areas are used for timber production.

A representative site index for this map unit for Rocky Mountain Douglas-fir is 80 on the Nordicol soil. It can produce about 69 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 40 years old.

The mass movement potential is rated low for this unit because of the slope and the high content of rock fragments.

The main concerns in producing and harvesting timber are equipment limitations because of the large stones and road construction in the stony soils. Conventional methods of harvesting timber can be used. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt and high rainfall.

Large stones limit rooting space and soil moisture, and interfere with planting operations. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Hand planting of nursery stock is usually necessary to establish or improve a stand if trees other than aspen are to be planted. Aspen will usually regenerate from roots after harvest.

The main limitations to the building of unsurfaced roads on Nordicol soil are the large stones and the slopes. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the growth of range and understory vegetation.

Wildlife such as elk, mule deer, bear, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by

livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the large stones in the surface and the slopes. Development is limited mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7s, nonirrigated.

606—Snowdon-Needleton complex, 45 to 90 percent slopes

Map Unit Description

This map unit is a complex of shallow and very deep, well drained soils on mountain slopes and ridges. The surface of this unit is covered with 3 to 15 percent stones. The elevation is 10,000 to 11,500 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 50 percent Snowdon stony loam, 35 percent Needleton stony loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used. Some areas have many snow chutes where snow slides occur.

Brief Soil Description

Snowdon stony loam

The Snowdon soil is shallow. It formed in colluvium and slope alluvium derived dominantly from red bed sandstone. Typically, the surface is covered with a mat of needles, leaves, and twigs about 2 inches thick. The surface layer is reddish brown stony loam about 4 inches thick. The subsurface layer is pinkish gray very stony sandy loam about 7 inches thick. The subsoil is reddish brown extremely stony sandy clay loam about 7 inches thick. Hard bedrock is at a depth of 20 inches; however, the depth to bedrock generally ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Snowdon soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Needleton stony loam

The Needleton soil is very deep. It formed in slope alluvium and colluvium derived dominantly from red bed sandstone. Typically, the surface is covered with a mat of organic material about 2 inches thick. The surface layer is reddish brown stony loam about 14 inches thick. The subsurface layer is reddish brown very cobbly sandy clay loam and light reddish brown very cobbly loam about 10 inches thick. The upper part of the subsoil is reddish brown very stony sandy clay loam about 22 inches thick; the lower part is reddish brown very cobbly clay loam to 62 inches or more.

The permeability of the Needleton soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Scotch loam, 3 percent Graysill loam, 2 percent Haviland loam, and 5 percent Rock outcrop. All three soils are on mountain slopes and have less than 35 percent rock fragments in the profile. Included areas

make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa*-*Picea engelmannii*/*Vaccinium myrtillus*. The native vegetation on this unit consists mainly of subalpine fir, Englemann's spruce, quaking aspen, whortleberry, and snowberry. Other plants that characterize this unit are Thurber's fescue, mountain brome, bluegrass, spike trisetum, sedge, needlegrass, Richardson's geranium, smallflowered woodrush, heartleaf arnica, and common juniper. The average annual understory production of air-dry vegetation is about 500 pounds per acre on the Snowdon soil, and about 800 pounds per acre on the Needleton soil.

Soil Management Implications

This unit is used for woodland, wildlife habitat, and limited livestock grazing.

A representative site index for this map unit for Englemann's spruce is 72 on the Snowdon soil. It can produce about 65 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 110 years old.

The mass movement potential is rated high for this unit because of the very steep slopes.

The main concerns in producing and harvesting timber are reforestation, preventing water erosion where vegetation has been removed, and the difficulty of road construction due to the shallow depth to bedrock in the Snowdon soils and the very steep slopes (*Fig. 13*). Only the less sloping areas should be considered for timber harvesting. Minimizing the risk of erosion is essential in harvesting timber.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.



Figure 13.—Snow chutes on Snowdon-Needleton complex, 45 to 90 percent slopes, are subject to frequent snowslides, which can prevent the establishment of trees.

Most areas of this unit are not used for grazing. The slope limits access by livestock and results in overgrazing of the less sloping areas. Deferred grazing will help to hasten revegetation and to improve areas in poor condition.

Wildlife such as elk, mule deer, bear, coyote, and blue grouse utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

This map unit is poorly suited to recreational development. The main limitations are the content of stones, the depth to bedrock in the Snowdon soil, and very steep slopes.

The Snowdon soil is in capability subclass 7s, nonirrigated. The Needleton soil is in capability subclass 7e, nonirrigated.

607—Graysill-Scotch complex, south aspect, 30 to 60 percent slopes

Map Unit Description

This map unit is a complex of moderately deep and shallow well drained soils on mountain slopes and ridges, and generally has a southern slope. The elevation is 9,000 to 11,500 feet. The average annual precipitation is 35 to 45 inches. The average annual air temperature is 30 to 38 degrees F., and the average frost-free season is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of about 45 percent Graysill loam, about 35 percent Scotch loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to separate them at the scale used.

Brief Soil Description

Graysill loam, south aspect

The Graysill soil is moderately deep. It formed in residuum and slope alluvium derived from red bed sandstone and shale. Typically the surface is covered with a two inch layer of organic material. The surface typically is a light reddish brown loam about 12 inches thick. The next layer is reddish brown clay loam about 8 inches thick. The subsoil is red clay loam to a depth of 37 inches. Red sandstone bedrock is at a depth of 37 inches; however, the depth to bedrock generally ranges from 20 to 40 inches from the mineral soil surface.

The permeability of the Graysill soil is moderately slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Scotch loam, south aspect

The Scotch soil is shallow. It formed in residuum and slope alluvium weathered from red bed sandstone and shale. Typically, the surface is covered with a two inch layer of organic material. The surface layer typically is a pale red loam about 5 inches thick. The subsoil is reddish brown clay loam to a depth of 17 inches. Sandstone bedrock is at 17 inches; however, the depth to bedrock generally ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Scotch soil is moderately slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Haviland loam and 10 percent Needleton stony loam, both on mountain slopes. Haviland and Needleton soils are very deep. Needleton soils have more than 35 percent rock fragments in the profile.

Vegetation

The dominant plant association is *Populus tremuloides*/*Carex geyeri*. Other plant associations include *Populus tremuloides*/*Symphoricarpos oreophilus*. The native vegetation consists mainly of quaking aspen, Thurber's fescue, mountain brome, bluegrass, and mountain snowberry. Other plants that characterize this unit are Letterman's needlegrass, kinnikinnick, Nevada pea, heartleaf arnica, Richardson's geranium, and elk sedge. A few subalpine fir and Englemann's spruce occur in some locations. The average annual understory production of air-dry vegetation is about 2,600 pounds per acre on the Graysill soil, and about 2,400 pounds per acre on the Scotch soil.

Soil Management Implications

This unit is used mainly for timber production, livestock grazing, wildlife habitat, and recreation.

A representative site index for this map unit for quaking aspen is 69 on the Graysill soil. It can produce about 38 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated moderate for this unit.

The primary concerns of management for timber production are reforestation, preventing water erosion where vegetative cover has been removed and the difficulty of road construction due to the limited depth to bedrock and the steep slopes. Management that minimizes the risk of erosion is essential in harvesting timber. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees if trees other than aspen are to be planted. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce, and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest.

The main limitations for building unsurfaced roads on this unit are the depth to bedrock and the steep slopes. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure desired quantity and quality of native vegetation. Livestock grazing should be managed so that the desired balance of species is maintained in the plant community. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Deferred grazing speeds up revegetation and to improves range and understory areas in poor condition.

Wildlife such as elk, mule deer, bear, coyote, and blue grouse utilize this soil. The forested areas provide food and protective cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes in the unit and the depth to bedrock in the Scotch soil. Steep slopes limit the use of the unit mainly to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

608—Scotch-Graysill complex, 30 to 60 percent slopes

Map Unit Description

This map unit is a complex of shallow and moderately deep, well drained soils on mountain slopes and ridges. The elevation is 9,000 to 11,500 feet. The average annual precipitation is 35 to 45 inches. The average annual air temperature is 30 to 38 degrees F., and the average frost-free season is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of about 45 percent Scotch loam, 35 percent Graysill loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to separate them at the scale used.

Brief Soil Description

Scotch loam

The Scotch soil is shallow. It formed in slope alluvium and residuum derived from red bed sandstone and shale. Typically, the surface is covered with a two inch layer of organic material. The surface layer typically is pale red loam about 5 inches thick. The subsoil is reddish brown clay loam to a depth of 17 inches. Sandstone bedrock is at 17 inches; however, the depth to bedrock generally ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Scotch soil is moderately slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Graysill loam

The Graysill soil is moderately deep. It formed in residuum and slope alluvium derived from red bed sandstone and shale. Typically the surface is covered with a two inch layer of organic material. The surface typically is a light reddish brown loam about 12 inches thick. The next layer is reddish brown light clay loam about 8 inches thick. The subsoil is red clay loam to a depth of 37 inches. Red sandstone bedrock is at a depth of 37 inches; however, the depth to bedrock generally ranges from 20 to 40 inches from the mineral soil surface.

The permeability of the Graysill soil is moderately slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Haviland loam and 10 percent Needleton stony loam, both on mountain slopes. Haviland and Needleton soils are very deep. Needleton soils have more than 35 percent rock fragments in the profile.

Vegetation

The dominant plant association is *Abies lasiocarpa*-*Picea engelmannii*/*Vaccinium myrtillus*. The native vegetation on this unit consists of subalpine fir, Englemann's spruce, and quaking aspen. Other plants that characterize this unit are whortleberry, elk sedge, Richardson's geranium, heartleaf arnica, mountain snowberry, Thurber's fescue, mountain brome, spike trisetum, kinnikinnick, and common juniper. The average annual understory production of air-dry vegetation is about 800 pounds per acre on both soils.

Soil Management Implications

This unit is used mainly for timber production, wildlife habitat, recreation, and livestock grazing.

A representative site index for this map unit for Englemann's spruce is 71 on the Scotch soil. It can produce about 64 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 110 years old.

The mass movement potential is rated moderate for this unit.

The primary concerns of management for timber production are reforestation, preventing water erosion where vegetation cover has been removed, and the difficulty of road construction due to the limited depth to bedrock and the steep slopes. Management that minimizes the risk of erosion is essential in harvesting timber. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce and lodgepole pine.

The main limitations for building unsurfaced roads on this unit are the shallow depth to bedrock of the Scotch soil and the steep slopes. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure desired quality and quantity of native vegetation. Deferred grazing speeds up revegetation and improves areas in poor condition. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Deferred grazing speeds up revegetation and improves range and understory areas in poor condition.

Wildlife such as elk, mule deer, bear, coyote, and blue grouse utilize this soil. The forested areas provide food and protective cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes in the unit and the depth to bedrock in the Scotch soils. Steep slopes limit the use of the unit mainly to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

609—Hourglass-Wander complex, 5 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 9,000 to 11,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 75 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 50 percent Hourglass loam, 35 percent Wander very cobbly loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Hourglass loam

The Hourglass soil formed in slope alluvium derived from sandstone and shale. Typically, the surface layer is dark grayish brown loam about 11 inches thick. The

upper part of the subsoil is brown clay loam about 7 inches thick; the middle part is brown gravelly clay loam about 13 inches thick; and the lower part is brown very stony clay loam about 15 inches thick. The substratum is brown very stony clay loam to a depth of 60 inches or more.

The permeability of the Hourglass soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Wander very cobbly loam

The Wander soil formed in slope alluvium derived mostly from sandstone and shale. Typically, the surface layer is dark grayish brown very cobbly loam about 14 inches thick. The subsoil is brown very cobbly clay loam about 26 inches thick. The substratum is mixed materials of light brown and reddish brown very cobbly clay loam to a depth of 60 inches or more.

The permeability of the Wander soil is moderately slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Haviland loam and about 4 percent Needleton loam, both on mountain slopes; and small areas of Sig gravelly loam on ridges. Haviland and Needleton soils have light colored surface layers. Sig soils are shallow. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Festuca thurberi*/*Festuca arizonica* and *Festuca thurberi*/*Vicia americana*-*Lathyrus leucanthus*. The native vegetation on this unit consists mainly of Thurber's fescue, bluegrass, nodding brome, mountain brome, and needlegrass. Other important plants that characterize this unit are American vetch, Parry's danthonia, Richardson's geranium, slender cinquefoil, Arizona fescue, prairie Junegrass, western wheatgrass, and sedge. The average annual production of air-dry vegetation is about 2,800 pounds per acre on the Hourglass soil and about 2,400 pounds per acre on the Wander soil.

Soil Management Implications

This unit is used for livestock grazing, recreation, and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope and the high content of rock fragments in the Wander soil.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of rangeland vegetation. More uniform use of rangeland is aided by properly locating salt and by herding. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Wildlife such as elk, mule deer, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife. Nearby forested areas provide cover for some of the wildlife.

If this map unit is used for recreational development, the main limitations are the content of stones and the slopes that are over 8 percent. Lower slopes that are not

cobbly may be developed for campgrounds or picnic areas. The slopes limit the use of most of the unit to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Hourglass soil is in capability subclass 6e, nonirrigated. The Wander soil is in capability subclass 7s, nonirrigated.

610—Wander-Hotter-Hourglass complex, 30 to 60 percent slopes

Map Unit Description

This map unit is a complex of very deep and shallow, well drained soils on mountain slopes and structural benches. The surface of this map unit is covered with 3 to 15 percent stones and cobbles. The elevation is 8,500 to 11,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 75 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 45 percent Wander very cobbly loam, 30 percent Hotter very stony sandy loam, 15 percent Hourglass loam, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Wander very cobbly loam

The Wander soil is very deep. It formed in colluvium and slope alluvium derived dominantly from sandstone and shale. Typically, the surface layer is dark grayish brown very cobbly loam about 14 inches thick. The subsoil is brown very cobbly clay loam about 26 inches thick. The substratum consists of mixed materials of light brown and reddish brown very cobbly clay loam to a depth of 60 inches or more.

The permeability of the Wander soil is moderately slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Hotter very stony sandy loam

The Hotter soil is shallow. It formed in slope alluvium and residuum derived dominantly from sandstone and shale. Typically, the surface layer is brown very stony sandy loam about 4 inches thick. The underlying material is yellowish brown very stony sandy loam to a depth of 14 inches. Sandstone bedrock is at a depth of 14 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Hotter soil is moderately rapid. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Hourglass loam

The Hourglass soil is very deep. It formed in colluvium and slope alluvium derived dominantly from sandstone, limestone, and shale. Typically, the surface layer is dark grayish brown loam about 11 inches thick. The upper part of the subsoil is brown clay loam about 7 inches thick; the middle part is brown gravelly clay loam about 13 inches thick; and the lower part is brown very stony clay loam about 15 inches thick. The substratum is brown very stony clay loam to a depth of 60 inches or more.

The permeability of the Hourglass soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or

more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Needleton stony loam and about 4 percent Haviland loam, both on mountain slopes; and small areas of Rock outcrop on breaks. Needleton and Haviland soils are very deep and have light colored surface layers. Included areas make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Festuca thurberi*/*Festuca arizonica* and *Festuca thurberi*/*Vicia americana*-*Lathyrus leucanthus*. The native vegetation on this unit consists mainly of Thurber's fescue, Arizona fescue, mountain brome, nodding brome, needlegrass, and bluegrass. Other important plants that characterize this unit are American vetch, Parry's danthonia, sedge, Richardson's geranium, shrubby cinquefoil, slender cinquefoil, prairie Junegrass, spike trisetum, and western wheatgrass. The average annual production of air-dry vegetation is about 2,800 pounds per acre on the Hourglass soil, about 2,100 pounds per acre on the Hotter soil, and about 2,400 pounds per acre on the Wander soil.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated moderate for this unit.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development

and fencing will help to improve livestock distribution and the production of rangeland plants. More uniform use of rangeland is aided by properly locating salt and by herding. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. The slope limits access by livestock and results in overgrazing of the less sloping areas.

Wildlife such as elk, mule deer, coyotes, hawks, and eagles utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife. Nearby forested areas provide cover for some of the wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes in the unit, the depth to bedrock in the Hotter soil, and the content of surface stones on the Wander soil. The slopes limit the use of the unit mainly to a few paths and trails, which should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

611—Goldbug very stony fine sandy loam, 5 to 30 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The surface of this unit is covered with 3 to 15 percent stones. The elevation is 7,500 to 8,500 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is 41 to 45

degrees F., and the average frost-free period is 90 to 110 days. The moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Goldbug very stony fine sandy loam

The Goldbug soil formed in slope alluvium derived dominantly from sandstone and shale. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is pinkish gray very stony fine sandy loam about 20 inches thick. The subsurface layer is light reddish brown and pink stony sandy clay loamy about 8 inches thick. The subsoil is reddish brown stony clay to a depth of 61 inches or more.

The permeability of the Goldbug soil is slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 10 percent Fortwingate stony sandy loam on mountain slopes; 3 percent Valto very stony fine sandy loam on ridges; and 2 percent Nordicol very stony loam on the steeper slopes. Fortwingate soils are moderately deep. Valto soils are shallow. Nordicol soils have dark colored surface layers. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation on this unit consists mainly of ponderosa pine, Gambel oak, Arizona fescue, and western wheatgrass. Other important plants that characterize this unit are Rocky Mountain Douglas-fir, mountain muhly, prairie Junegrass, mountain brome, true mountain mahogany, and common juniper. The average annual understory production of air-dry vegetation is about 900 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 70 on the Goldbug soil. It can produce about 55 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Conventional methods of harvesting timber can be used. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Brushy plants such as Gambel oak limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Ponderosa pine is among the trees that are suitable for planting.

The main limitations to the building of unsurfaced roads on this unit are the content of stones in the soil and on the surface. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of understory vegetation. If the condition of the range or understory deteriorates, Gambel oak increases. Areas where brush is managed by prescribed burning, chemical or mechanical methods may be subject to a greater hazard of erosion. If the range or understory vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the content of stones on the surface, and the slope. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the content of surface stones and the slope. The slope limits use of the unit mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7s, nonirrigated.

612—Haviland-Graysill complex, 5 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep and moderately deep, well drained soils on mountain slopes and mesas. The elevation is 9,000 to 11,500 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of about 50 percent Haviland loam, 35 percent Graysill loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to separate them at the scale used.

Brief Soil Description

Haviland loam

The Haviland soil is very deep. It formed in slope alluvium derived dominantly red bed sandstone and shale. Typically, the surface is covered with a mat of decomposing leaves and twigs about 2 inches thick. The surface layer is light reddish brown loam about 12 inches thick. The upper 10 inches of the subsoil are red clay loam; the lower part consists of reddish brown gravelly clay loam extending to 62 inches or more.

The permeability of the Haviland soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Graysill loam

The Graysill soil is moderately deep. It formed in residuum and slope alluvium derived from red bed sandstone and shale. Typically the surface is covered with a layer of organic material about 2 inches thick. The surface typically is a light reddish brown loam about 12 inches thick. The next layer is reddish brown clay loam about 8

inches thick. The subsoil is red clay loam to a depth of 37 inches. Red sandstone bedrock is at a depth of 37 inches; however, the depth to bedrock generally ranges from 20 to 40 inches from the mineral soil surface.

The permeability of the Graysill soil is moderately slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Needleton loam on mountain slopes; 3 percent Scotch loam on ridges; and 2 percent Snowdon loam on mountain slopes. Needleton soils have more than 35 percent rock fragments in the profile. Scotch and Snowdon soils are shallow. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, and quaking aspen. Other important plants that characterize this unit are whortleberry, Thurber's fescue, elk sedge, mountain brome, bluegrass, heartleaf arnica, Richardson's geranium, smallflowered woodrush, spike trisetum, kinnikinnick, and mountain snowberry. The average annual understory production of air-dry vegetation is about 900 pounds per acre on the Haviland soil and about 800 pounds per acre on the Graysill soil.

Soil Management Implications

This unit is used mainly for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for Englemann's spruce is 85 on the Graysill soil. It can produce about 83 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetative cover has been removed. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce and lodgepole pine.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Wildlife such as elk, mule deer, squirrels, rabbits, coyotes, blue grouse, and bear utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover.

If this map unit is used for recreational development, the main limitation is the presence of slopes that are over 8 percent. Lower slopes may be developed. The slopes limit use of most of the areas to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

615—Haviland loam, 30 to 60 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 9,000 to 11,500 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 32 to 38 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Haviland loam

The Haviland soil formed in slope alluvium and colluvium derived dominantly from red bed sandstone and shale. Typically, the surface is covered with a mat of decomposing leaves and twigs about 2 inches thick. The surface layer is light reddish brown loam about 12 inches thick. The upper 10 inches of the subsoil are red clay loam; the lower part is reddish brown gravelly clay loam extending to 62 inches or more.

The permeability of the Haviland soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 10 percent Graysill loam and 10 percent Needleton stony loam, both on mountain slopes; and 5 percent Scotch loam on ridges. Graysill soils are moderately deep. Needleton soils have more than 35 percent rock fragments in the profile. Scotch soils are shallow. Included soils make up about 25 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa*-*Picea engelmannii*/*Vaccinium myrtillus*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, and quaking aspen. Other important plants that characterize this unit are whortleberry, Thurber's fescue, mountain brome, bluegrass, elk sedge, smallflowered woodrush, spike trisetum, kinnikinnick, Richardson's geranium, heartleaf arnica, and mountain snowberry. The average annual understory production of air-dry vegetation is about 900 pounds per acre.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for Englemann's spruce is 90 on the Haviland soil. It can produce about 91 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 90 years old.

The mass movement potential is rated moderate for this unit.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetative cover has been removed. Minimizing the risk of erosion is essential in harvesting timber.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. Planting nursery stock will hasten reforestation.

Hand planting is usually necessary because of the slope. Among the trees that are suitable for planting are Englemann's spruce and lodgepole pine.

The main limitation to the building of unsurfaced roads on this unit is the presence of steep slopes. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure.

Wildlife such as elk, mule deer, squirrels, rabbits, coyotes, blue grouse, and bear utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover.

If this map unit is used for recreational development the main limitation is the presence of steep slopes. These slopes limit the use of the unit mainly to a few paths and trails, which should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

616—Fortlewis stony fine sandy loam, 3 to 12 percent slopes

Map Unit Description

This moderately deep, well drained soil is on mountain slopes. The elevation is 7,500 to 8,500 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is 41 to 45 degrees F., and the average frost-free period is 90 to 110 days. The moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Fortlewis stony fine sandy loam

The Fortlewis soil formed in slope alluvium derived dominantly from sandstone and shale. Typically, the surface is covered with a mat of organic material of needles and leaves about 1 inch thick. The surface layer is brown stony fine sandy loam about 3 inches thick. The subsurface layer is pinkish gray stony fine sandy loam about 8 inches thick. The upper 5 inches of the subsoil are reddish brown clay loam and light brown sandy clay loam; the next 10 inches are light reddish brown clay; and the lower part is reddish yellow clay to a depth of about 39 inches. Sandstone bedrock is at a depth of 39 inches; however, the depth to bedrock generally ranges from 20 to 40 inches from the mineral soil surface.

The permeability of the Fortlewis soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 10 percent Goldbug very stony fine sandy loam on mountain slopes; small areas of Valto very stony fine sandy loam on ridges; and small areas of Nordicol very stony loam on hillslopes. Goldbug soils are very deep. Valto soils are shallow. Nordicol soils are very deep and have more than 35 percent rock

fragments in the profile. Included soils make up about 15 percent of the total acreage; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation on this unit consists mainly of ponderosa pine, Gambel oak, Arizona fescue, prairie Junegrass, and mountain muhly. Other important plants that characterize this unit are mountain brome, bluegrass, pine dropseed, western wheatgrass, and true mountain mahogany. The average annual understory production of air-dry vegetation is about 850 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 69 on the Fortlewis soil. It can produce about 54 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the slope and the depth to bedrock.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. Brushy plants such as Gambel oak limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Stones in the surface can make tree planting difficult. Among the trees that are suitable for planting is ponderosa pine.

The main limitations for building unsurfaced roads on this unit are the depth to bedrock and the slope. Proper design of road drainage systems and care in the placement of culverts help to control erosion. The depth to bedrock can interfere with road construction. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing waterbars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory vegetation.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the content of stones in the surface, the slow permeability, and the slopes that are over 8 percent. Paths and trails can be developed.

This map unit is in capability subclass 6e, nonirrigated.

617—Shawa loam, 5 to 20 percent slopes

Map Unit Description

This very deep, well drained soil is on alluvial fans. The elevation is 7,000 to 8,400 feet. The average annual precipitation is 18 to 20 inches, the average annual air

temperature is 40 to 46 degrees F., and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include Hesperus loam. These similar soils make up about 10 percent of the total acreage; the percentage varies from one area to another.

Brief Soil Description

Shawa loam

The Shawa soil formed in alluvium derived dominantly from sandstone and shale. Typically, the surface layer is brown loam about 19 inches thick. The upper 19 inches of the subsoil are brown clay loam; the lower part consists of brown cobbly clay loam to a depth of 60 inches or more.

The permeability of the Shawa soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit is about 5 percent of soils that have more than 35 percent rock fragments in the profile. These inclusions are on alluvial fans.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation on this unit consists mainly of ponderosa pine, Gambel oak, Arizona fescue, prairie Junegrass, mountain brome, bluegrass, and western wheatgrass. Other important plants that characterize this unit are mountain muhly, Indian ricegrass, and needleandthread. The average annual understory production of air-dry vegetation is about 1,200 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 78 on the Shawa soil. It can produce about 65 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the slope.

The Shawa soil is well suited to the production of ponderosa pine. The main concerns in producing and harvesting timber are reforestation and preventing erosion along roads and other disturbed areas. Conventional methods of harvesting timber can be used.

Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Properly preparing the site by spraying, cutting, or girdling to eliminate unwanted weeds, brush or trees can control competing vegetation. Brushy plants such as Gambel oak limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting is ponderosa pine.

The main limitation to building unsurfaced roads on this soil is the low strength. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory vegetation. If the condition of the understory

deteriorates, oak brush increases. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, and squirrels utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitation is the presence of slopes that are over 8 percent. Camp areas and picnic areas can be developed on the lower slopes. Paths and trails can be developed. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

618—Nordicol-Valto complex, 30 to 70 percent slopes

Map Unit Description

This map unit is a complex of very deep and shallow, well drained soils on mountain slopes and ridges. The elevation is 8,000 to 9,500 feet. The average annual precipitation is 20 to 28 inches, the average annual air temperature is 38 to 42 degrees F. for Nordicol, and from 40 to 44 degrees F. for Valto, and the average frost-free period is 60 to 100 days. The moisture regimes are ustic-udic for Nordicol and ustic for Valto. The temperature regimes are cryic for Nordicol and frigid for Valto.

This map unit consists of 50 percent Nordicol very stony loam, 35 percent Valto very stony fine sandy loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Nordicol very stony loam

The Nordicol soil is very deep. It formed in slope alluvium and colluvium derived dominantly from sandstone. Typically, the surface is covered with a mat of organic material about 2 inches thick. The surface layer is dark grayish brown very stony loam about 19 inches. The subsurface layer is light brown very stony sandy loam about 8 inches. The subsoil is brown very stony sandy clay loam about 24 inches thick. The substratum is light yellowish brown extremely stony sandy loam to a depth of 62 inches or more.

The permeability of the Nordicol soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Valto very stony fine sandy loam

The Valto soil is shallow. It formed in residuum derived dominantly from sandstone. Typically, the surface is covered with a mat of decomposing needles, leaves, and twigs about 2 inches thick. The surface layer is dark reddish gray very stony fine sandy loam about 2 inches thick. The subsurface layer is light reddish brown very stony fine sandy loam about 10 inches thick. Sandstone bedrock is at a depth of 14 inches; however, the depth to bedrock generally ranges from 10 to 20 inches from the mineral soil surface.

The permeability of the Valto soil is moderately rapid. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Frisco stony loam and 5 percent Pinacol loam, both on mountain slopes; small areas of soils that are moderately deep over bedrock on ridges; and small areas of Rock outcrop on breaks. Frisco soils are very deep and have light colored surface layers. Pinacol soils have clayey-skeletal subsoils. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. *Pseudotsuga menziesii/Quercus gambelii* occurs on north slopes. The native vegetation on this unit consists mainly of ponderosa pine, white fir, Gambel oak, Arizona fescue, and common snowberry. Other important plants that characterize this unit are Rocky Mountain Douglas-fir, Englemann's spruce, quaking aspen, Saskatoon serviceberry, mountain brome, nodding brome, prairie Junegrass, mountain muhly, elk sedge, bluegrass, Nevada pea, and true mountain mahogany.

The average annual understory production of air-dry vegetation is about 1,200 pounds per acre on the Nordicol soil, and about 500 pounds per acre on the Valto soil.

Soil Management Implications

This unit is used for livestock grazing, timber production, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 78 on the Nordicol soil. It can produce about 65 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for the Valto soil because of the shallow depth to bedrock, and it is rated moderate for the Nordicol soil because of the steep slopes.

This unit is moderately suited to the production of ponderosa pine. The main concerns in producing and harvesting timber are revegetation and road construction. Conventional harvesting methods generally are restricted to slopes of less than 40 percent. Access to the steeper areas is limited. The steepness of the slopes limits the kinds of equipment that can be used in forest management.

The main limitations to reforestation on this unit are the shallow depth to bedrock in the Valto soil and the steep slopes and content of large stones in the Nordicol soil. Large stones limit rooting space and soil moisture, and interfere with planting operations. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees. Competing vegetation can be controlled by properly preparing the site and by burning to eliminate unwanted weeds, brush, or trees. Brushy plants such as Gambel oak limit natural regeneration of ponderosa pine. Hand planting of nursery stock is usually necessary to establish or improve a stand. Trees that are suitable for planting are ponderosa pine and Rocky Mountain Douglas-fir.

The main limitations to the building of unsurfaced roads on this unit are the shallow depth to rock on the Valto soil and the steep slopes and content of large stones in the Nordicol soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory vegetation.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes, the content of large stones, and the depth to bedrock in the Valto soil. The slopes limit the use of the unit mainly to a few paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Nordicol soil is in capability subclass 7e, nonirrigated. The Valto soil is in capability subclass 7s, nonirrigated.

619—Nordicol extremely stony loam, 45 to 75 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The surface is covered with 3 to 15 percent stones. The elevation is 9,000 to 11,000 feet. The average annual precipitation is 25 to 35 inches, the average annual air temperature is 38 to 42 degrees F., and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Nordicol extremely stony loam

The Nordicol soil formed in colluvium and slope alluvium derived dominantly from sandstone and quartz diorite. Typically, the surface is covered with a mat of organic material about 2 inches thick. The surface layer is very dark grayish brown extremely stony loam about 15 inches thick. The subsurface layer is very pale brown very cobbly sandy clay loam about 14 inches thick. The subsoil is pale brown extremely cobbly sandy clay loam to a depth of 62 inches or more.

The permeability of the Nordicol soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Frisco stony loam, 5 percent Horsethief loam, and 5 percent Snowdon extremely stony loam, all on mountain slopes; and about 5 percent Rock outcrop and Rubble land. Frisco and Horsethief soils have light colored surface layers. Snowdon soils are shallow. Included areas make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Abies lasiocarpa-Picea engelmannii/Carex geyeri* and *Pseudotsuga menziesii/Amelanchier alnifolia*. The native vegetation on this unit consists mainly of Rocky Mountain Douglas-fir, Englemann's spruce, subalpine fir, white fir, and ponderosa pine. Other important plants that characterize this unit are Thurber's fescue, Saskatoon serviceberry, elk sedge, kinnikinnick, bluegrass, mountain brome, mountain muhly, Gambel oak, and snowberry. The average annual understory production of air-dry vegetation is about 1,200 pounds per acre.

Soil Management Implications

This unit is used for wildlife habitat, woodland, and limited livestock grazing.

A representative site index for this map unit for Rocky Mountain Douglas-fir is 78

on the Nordicol soil. It can produce about 65 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated moderate for this unit.

This unit is poorly suited to timber production. The main concerns in producing and harvesting timber are reforestation and road construction due to steep slopes, cobbles, and stones. Timber productivity is estimated to be low. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. The steepness of slope limits the kinds of equipment that can be used in forest management. Only the lower slopes should be considered for timber harvesting. Minimizing the risk of erosion is essential in harvesting timber.

Large stones limit rooting space and soil moisture, and interfere with planting operations. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Among the trees that are suitable for planting are Englemann's spruce and lodgepole pine. Other trees suited to this unit are subalpine fir and Rocky Mountain Douglas-fir.

The main limitations to the building of unsurfaced roads on this unit are the steep slopes, the content of large stones, and rock outcrops. Careful consideration of road systems and harvesting methods should be made to minimize erosion. Proper design of road drainage systems and care in the placement of culverts help to control erosion.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. The slope limits access by livestock and results in overgrazing of the less sloping areas. Mechanical treatment practices are not practical because the surface is stony and the slopes are steep.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes and the content of stones. The slopes limit use of the unit mainly to a few paths and trails, which should extend across the slopes. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

620—Caviness loam, 15 to 30 percent slopes

Map Unit Description

This deep, well drained soil is on mountain slopes. The elevation is 8,800 to 10,600 feet. The average annual precipitation is 25 to 35 inches, the average annual air temperature is 34 to 40 degrees F., and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Caviness loam

The Caviness soil formed in slope alluvium and residuum derived dominantly from Dakota sandstone. Typically, the surface is covered with a mat of leaves and twigs about 3 inches thick. The surface layer is grayish brown loam about 10 inches thick. The subsurface layer is brown stony loam about 8 inches thick, and the next layer is pink stony sandy clay loam about 11 inches thick. The upper 19 inches of the subsoil are light red clay, and the lower 7 inches are yellowish red sandy clay. Hard Dakota

sandstone is at a depth of 58 inches; however, the depth to bedrock generally ranges from 40 to 60 inches from the mineral soil surface.

The permeability of the Caviness soil is slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 40 to 60 inches. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low in the upper part of the profile and high in the lower part.

Contrasting Inclusions

Included in this unit are about 5 percent Nordicol stony loam on mountain slopes; 4 percent Clayburn loam on toeslopes and in drainageways and small areas of soil that contains large boulders. Nordicol soils have more than 35 percent rock fragments in the profile. Clayburn soils have fine-loamy subsoils and thick dark surface layers. Included soils make up about 10 percent of the total acreage; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus*. The native vegetation on this unit consists mainly of quaking aspen, common snowberry, meadow-rue, and Nevada pea. Other important plants that characterize this unit are mountain brome and elk sedge. The average annual understory production of air-dry vegetation is about 2,000 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for quaking aspen is 80 on the Caviness soil. It can produce about 48 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit.

This unit is well suited to the production of aspen. The main concerns in producing and harvesting timber are reforestation if trees other than aspen are to be planted. Conventional methods of harvesting timber can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitations to reforestation, if trees other than aspen are to be grown, are the dense stands of aspen regenerating from roots. Among the trees that are suitable for planting are Douglas fir, white fir, and lodgepole pine. Aspen will reproduce from roots after harvesting (*Fig. 14*).

Harvesting some of the mature trees and thinning dense stands of younger trees for use as poles increase the growth rate of the rest of the stand and increase the understory vegetation.

The main limitations to the building of unsurfaced roads on this unit are the slopes, the high clay content of the subsoil horizon, and the content of large boulders. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Stock water development and fencing will help to improve livestock distribution and the production of native understory vegetation.

Wildlife such as elk, mule deer, bear, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.



Figure 14.—Quaking aspen on Caviness loam, 15 to 30 percent slopes. The area on the left has been clear-cut and aspen are regenerating from roots.

If this map unit is used for recreational development, the main limitation is the slope. The slope limits most of the areas to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

621—Granturk Loam, 5 to 25 percent slopes

Map Unit Description

This shallow or very shallow, well drained soil is on alpine mesas and structural benches. The elevation is 11,500 to 13,000 feet. The average annual precipitation is 35 to 50 inches, the average annual air temperature is 28 to 34 degrees F., and the average frost-free period is 30 to 40 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Granturk loam

The Granturk soil formed in residuum derived dominantly from red bed sandstone. Typically, the surface is covered with a mat of organic material about 1 inch thick. The surface layer is weak red loam about 7 inches thick. The upper 9 inches of the subsoil are pale red loam, and the lower 2 inches are pale red very gravelly sandy loam. Sandstone bedrock is at a depth of 19 inches; however, the depth to bedrock generally ranges from 7 to 20 inches from the mineral soil surface.

The permeability of the Granturk series is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 7 to 20 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Henson very gravelly loam on the steeper slopes; 5 percent Whitecross very stony sandy loam on ridges; and 5 percent Rock outcrop. Henson soils are very deep. Whitecross soils have more than 35 percent rock fragments in the profile.

Vegetation

The dominant plant associations are *Kobresia myosuroides*/*Trifolium dasyphyllum* and *Deschampsia cespitosa*/*Carex spp.* The native vegetation on this unit consists mainly of kobresia, tufted hairgrass, alpine fescue, and alpine bluegrass. Other important plants that characterize this unit are arctic bluegrass, spreading wheatgrass, Baker's wheatgrass, Ross' avens, sedge, and alpine clover. The average annual production of air-dry vegetation is about 900 pounds per acre.

Soil Management Implications

This unit is used for sheep grazing, wildlife habitat, and recreation.

The mass movement potential is rated low for this unit because of the shallow depth to bedrock.

This unit is well suited to the production of alpine vegetation. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development will help to improve livestock distribution and the production of native vegetation. Livestock grazing is limited by a short growing season.

Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. More uniform use of rangeland is aided by properly locating salt and by herding.

Wildlife such as elk, mule deer, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the depth to bedrock, the slope, and the high elevation. Development is limited mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched. Vehicle traffic should be limited to roads and trails because disturbed areas are subject to erosion and are very slow to revegetate.

This map unit is in capability subclass 6e, nonirrigated.

622—Granturk-Rock outcrop complex, 25 to 60 percent slopes

Map Unit Description

This map unit is a complex of shallow and very shallow, well drained soils and Rock outcrop on alpine mountain slopes and escarpments. The elevation is 11,500 to 13,000 feet. The average annual precipitation is 35 to 50 inches, the average annual air temperature is 28 to 34 degrees F, and the average frost-free period is 30 to 40 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 60 percent Granturk loam, 30 percent Rock outcrop, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Granturk Loam

The Granturk soil formed in slope alluvium and residuum derived dominantly from red bed sandstone. Typically the surface is covered with a mat of organic material about 1 inch thick. The surface layer is weak red loam about 7 inches thick. The upper 9 inches of the subsoil are pale red loam, and the lower 2 inches are pale red very gravelly sandy loam. Sandstone bedrock is at a depth of 19 inches; however, the depth to bedrock generally ranges from 7 to 20 inches from the mineral soil surface.

The permeability of the Granturk series is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 7 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of sandstone outcrop on escarpments, on the edges of structural benches, and on very steep mountain backslopes.

Contrasting Inclusions

Included in this unit are about 5 percent Henson very gravelly loam on mountain slopes, and 5 percent Whitecross very stony sandy loam on mountain slopes and ridges. Henson soils are very deep. Whitecross soils have more than 35 percent rock fragments in the profile.

Vegetation

The dominant plant associations are *Kobresia myosuroides*/*Trifolium dasyphyllum* and *Deschampsia cespitosa*/*Carex spp.* The native vegetation on this unit consists mainly of kobresia, tufted hairgrass, alpine fescue, and alpine bluegrass. Other important plants that characterize this unit are arctic bluegrass, spreading wheatgrass, Baker's wheatgrass, Ross' avens, sedge, and alpine clover. The average annual production of air-dry vegetation is about 900 pounds per acre.

Soil Management Implications

This unit is used for sheep grazing, wildlife habitat, and recreation.

The mass movement potential is rated low for this unit because of the shallow depth to bedrock.

This unit is moderately suited to the production of alpine vegetation. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Livestock grazing is limited by a short growing season. Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. More uniform use of rangeland is aided by properly locating salt and by herding.

Wildlife such as elk, mule deer, pika, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes, the depth to bedrock, rock outcrops, the hazard of erosion, and the high elevations. The slope limits use of the unit mainly to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched. Vehicle traffic should be limited to roads and trails because disturbed areas are subject to erosion and are very slow to revegetate.

The Granturk soil is in capability subclass 7e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

623—Chris-Nordicol complex, 15 to 45 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 8,500 to 10,000 feet. The average annual precipitation is 30 to 40 inches, the average annual air temperature is 36 to 40 degrees F., and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 50 percent Chris gravelly loam, 40 percent Nordicol very stony loam, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Chris gravelly loam

The Chris soil formed in slope alluvium derived mostly from sandstone. Typically, the surface is covered with a mat of partly decomposed needles and leaves 1 inch thick. The surface layer is pinkish gray gravelly loam about 12 inches thick. The subsurface layer is mixed pinkish gray gravelly sandy clay loam and reddish brown gravelly clay loam about 10 inches thick. The upper part of the subsoil is mixed light reddish brown very cobbly clay loam and pinkish gray very cobbly loam about 8 inches thick. The lower part of the subsoil is light reddish brown very cobbly clay loam about 11 inches thick. The substratum is light reddish brown very cobbly sandy clay loam to a depth of 61 inches or more.

The permeability of the Chris soil is slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Nordicol very stony loam

The Nordicol soil formed in slope alluvium derived mostly from sandstone. Typically, the surface is covered with a mat of leaves, needles, and roots about 2 inches thick. The surface layer is dark grayish brown very stony loam about 19 inches thick. The subsurface layer is light brown very stony sandy loam about 8 inches thick. The subsoil is brown very stony sandy clay loam about 24 inches thick. The substratum is light yellowish brown extremely stony sandy loam to a depth of 62 inches or more.

The permeability of the Nordicol soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Needleton stony loam and about 5 percent of soil moderately deep over bedrock, both on mountain slopes. Needleton soils have loamy-skeletal subsoils. Included areas make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Abies lasiocarpa*-*Picea engelmannii*/*Carex geyeri* on the Chris soil and *Populus tremuloides*/*Symphoricarpos oreophilus* on the

Nordic soil. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, Rocky Mountain Douglas-fir, quaking aspen, white fir, and ponderosa pine. Other plants that characterize this unit are Gambel oak, snowberry, elk sedge, Arizona fescue, mountain brome, western wheatgrass, mountain muhly, Thurber's fescue, bluegrass, nodding brome, Saskatoon serviceberry, Nevada pea, rose, and heartleaf arnica. The average annual understory production of air-dry vegetation is about 700 pounds per acre on the Chris soil, and about 2,000 pounds per acre on the Nordic soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for Englemann's spruce is 89 on the Chris soil. It can produce about 89 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the stones and cobbles in the soil.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Conventional harvesting methods can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants, especially on the Nordic soil. Brushy plants such as Gambel oak, and snowberry limit natural regeneration. The high content of rock fragments can make the planting of seedlings difficult. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce and lodgepole pine. Other trees suited to this unit are Rocky Mountain Douglas-fir and subalpine fir. Quaking aspen will usually regenerate from roots after harvest. Timber productivity is estimated to be high on both soils.

The main limitations to the building of unsurfaced roads on Chris and Nordic soils are the slopes and the stoniness. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of vegetation useable to livestock.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the slopes, the slow permeability of the Chris soil, and the content of stones in the Nordic soil. The slopes limit use of the unit mainly to a few paths and trails, which should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

699—Haplocryolls-Rubble land complex, 10 to 60 percent slopes

Map Unit Description

This map unit is a complex of moderately deep to very deep, well drained soils and rubble land on mountain slopes below ledges and cliffs. The elevation is 8,000 to 10,000 feet. The average annual precipitation is 25 to 35 inches, the average annual air temperature is 35 to 40 degrees F, and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

This unit consists of 40 percent Haplocryolls, 40 percent Rubble land, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Haplocryolls

Haplocryolls vary considerably in properties. They formed in slope alluvium and colluvium derived from sandstone and limestone. In a reference pedon, the surface is covered with a mat of organic material about 2 inches thick. The surface layer is dark grayish brown very cobbly loam about 17 inches thick. The subsoil is brown very cobbly clay loam about 10 inches thick. The substratum is brown very cobbly sandy clay loam to 62 inches or more. The amount of rock fragments in the soil ranges from 35 to 80 percent. The texture of the control section is loam, clay loam, or sandy clay loam with varying rock fragment modifiers. The depth to bedrock ranges from 20 to 60 inches or more from the mineral soil surface.

The permeability of the Haplocryolls soil is moderate to moderately slow. The available water capacity is low to moderate. The hydrologic group is B. The effective rooting depth is 20 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Rubble land

Rubble land consists of colluvial deposits of rock fragments. It contains 50 to 80 percent boulders and stones that have broken from rock ledges and cliffs above the map unit.

Contrasting Inclusions

Included in this unit are about 10 percent Needleton stony loam and 5 percent Haviland loam, both on mountain slopes; and 5 percent Snowdon stony loam on mountain slopes and breaks. These inclusions are mostly at the higher elevations. Needleton and Haviland soils have light colored surface layers. Snowdon soils are shallow.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus*. The native vegetation on this unit consists mainly of quaking aspen, common snowberry, Thurber's fescue, and western wheatgrass. Other important plants that characterize this unit are Rocky Mountain Douglas-fir, Englemann's spruce, mountain brome, mountain muhly, prairie Junegrass, bluegrass, serviceberry, and elk sedge. The average annual understory production of air-dry vegetation is about 2,000 pounds per acre on the Haplocryolls soil.

Soil Management Implications

This unit is used for woodland, wildlife habitat, and limited livestock grazing. It generally is too stony for commercial timber production.

A representative site index for this map unit for quaking aspen is 65 on the Haplocryolls soil. It can produce about 36 cubic feet of timber per acre from a fully stocked stand of even-aged trees 80 years old.

The mass movement potential is rated high for this unit because of the steep slopes.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. The slope limits access by livestock and results in overgrazing of the less sloping areas.

Wildlife such as elk, mule deer, squirrels, rabbits, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover.

If this map unit is used for recreational development, the main limitations are the steep slopes and the content of large stones. The slopes limit use of the unit mainly to a few paths and trails, which should extend across the slope. Cuts and fills should be seeded or mulched.

The Haplocryolls soil is in capability subclass 7e, nonirrigated. Rubble Land is in capability subclass 8s, nonirrigated.

NOTE: This map unit was formerly Haplustolls, cool. Before that it was Haploborolls to match the La Plata Soil Survey Area.

700—Bradfield clay loam, 0 to 5 percent slopes

Map Unit Description

This very deep, well drained soil is on mesas and alluvial fans. The elevation is 7,600 to 8,500 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is 40 to 44 degrees F., and the average frost-free period is 80 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include Narraguinnep clay loam, Typic Haplustolls, and Pachic Haplustolls. These similar soils make up about 10 percent of the total acreage; the percentage varies from one area to another.

Brief Soil Description

Bradfield clay loam

The Bradfield soil formed in slope alluvium and alluvium derived mostly from shale. Typically, the surface layer is grayish brown clay loam about 7 inches thick. The upper part of the subsoil is brown clay loam about 8 inches thick; the next part is dark grayish brown clay about 13 inches thick; and the lower part is brown and yellowish brown clay about 8 inches thick. The substratum is light yellowish brown clay to a depth of 60 inches or more. The similar Narraguinnep soils do not have deep cracks or slickensides. Typic Haplustolls and Pachic Haplustolls have argillic horizons.

The permeability of the Bradfield soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Vegetation

The dominant plant association is *Artemisia tridentata/Elytrigia smithii*. The native vegetation on this unit consists mainly of western wheatgrass, mountain big sagebrush, Arizona fescue, mountain brome, and Columbia needlegrass. Other important plants that characterize this unit are prairie Junegrass, muttongrass, and mountain muhly. The average annual production of air-dry vegetation is about 1,100 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated very low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this soil are the low strength and the high shrink-swell potential.

The surface textures are high in clay and are easily compacted. A dense vegetative ground cover should be maintained to prevent an excess of this damage. The vegetation will also help prevent soil cracking which can dry the soil and reduce productivity.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range vegetation. More uniform use of rangeland is aided by properly locating salt and by herding. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitation is the slow permeability.

This map unit is in capability subclass 4c, nonirrigated.

703—Narraguinnep clay loam, 15 to 50 percent slopes**Map Unit Description**

This very deep, well drained soil is on mountain slopes. The elevation is 7,600 to 8,500 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is 40 to 43 degrees F., and the average frost-free period is 70 to 90 days. The moisture and temperature regimes are ustic and frigid, respectively.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not to affect the use or management of the unit. These include Bradfield clay loam and Gladlow clay loam. These similar soils make up about 15 percent of the total acreage; the percentage varies from one area to another.

Brief Soil Description**Narraguinnep clay loam**

The Narraguinnep soil formed in slope alluvium derived dominantly from shale. Typically, the surface is dark grayish brown clay loam about 6 inches thick. The upper 17 inches of the subsoil are grayish brown clay, and the lower 7 inches are grayish brown clay loam. The substratum is pale brown clay to a depth of 60 inches or more. The similar Bradfield soils have deep cracks and slickensides. Gladlow soils have light colored surface layers.

The permeability of the Narraguinnep soil is slow. The available water capacity is high. The hydrologic group is D. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit is about 5 percent of soils that have shale bedrock above a depth of 40 inches on mountain slopes.

Vegetation

The dominant plant association is *Quercus gambelii*/*Symphoricarpos oreophilus*. The native vegetation on this unit consists mainly of Gambel oak, mountain snowberry, Arizona fescue, mountain brome, bluegrass, western wheatgrass, slender wheatgrass, and basin big sagebrush (Fig. 15). Other important plants that characterize this unit are needleandthread, elk sedge, mountain muhly, Saskatoon serviceberry, and a few twoneedle pinyon and Utah juniper. The average annual production of air-dry vegetation is about 2,000 pounds per acre.

Soil Management Implications

This unit is used for wildlife habitat and livestock grazing.

The mass movement potential is rated high for this unit because of the moderately steep slopes and the clayey textures.

The main limitations to the building of unsurfaced roads on Narraguinnep soil are the slope, the low strength, and the shrink-swell potential. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and range production.



Figure 15.—Gambel oak and snowberry are the most obvious plants on the Brushy Loam range site on Narraguinnep clay loam.

Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning, chemical, or mechanical methods may be subject to a greater hazard of erosion. The main limitations for seeding are the moderately steep slopes and the shrubs.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this unit is used for recreational development, the main limitations are the slopes, the slow permeability, and the hazard of erosion. The slopes limit use of the unit mainly to a few paths and trails, which should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched. Erosion and sedimentation can be controlled and the beauty of the area enhanced by maintenance of adequate plant cover.

This map unit is in capability subclass 7e, nonirrigated.

704—Gladlow-Rock outcrop-Ruko complex, 3 to 15 percent slopes

Map Unit Description

This map unit is a complex of very deep and shallow, well drained soils and Rock outcrop on mesas. The elevation is 7,500 to 7,800 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is 42 to 45 degrees F., and the average annual frost-free period is 80 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 30 percent Gladlow silty clay loam, 30 percent Rock outcrop, 20 percent Ruko silty clay loam, and 20 percent included soils.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not to affect the use of management of the unit. These include Narraguinnep clay loam and soils moderately deep over shale. These similar soils make up about 20 percent of the total acreage; the percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Gladlow silty clay loam

The Gladlow soil is very deep. It formed in slope alluvium derived dominantly from shale. Typically, the surface layer is brown silty clay loam about 5 inches thick. The upper 19 inches of the subsoil are brown silty clay, and the lower 7 inches are light brownish gray silty clay. The substratum is variegated gray and pale brown clay loam to a depth of 60 inches or more. The similar Narraguinnep soils have deep dark surface layers.

The permeability of the Gladlow soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Rock outcrop

Rock outcrop consists of exposed shale bedrock.

Ruko silty clay loam

The Ruko soil is shallow. It formed in residuum derived from shale. Typically, the surface layer is brown silty clay loam about 2 inches thick. The underlying material is

light brownish gray silty clay loam to a depth of about 11 inches. Calcareous shale is at a depth of about 11 inches; however, the depth to shale generally ranges from 10 to 20 inches.

The permeability of the Ruko soil is slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Vegetation

The dominant plant association is *Artemisia tridentata/Oryzopsis hymenoides*. Some *Artemisia tridentata/Elytrigia smithii* may also occur on similar landscapes. The native vegetation on this unit consists mainly of black sagebrush, big sagebrush, Indian ricegrass, Arizona fescue, and western wheatgrass. Other important plants that characterize this unit are flowery phlox, lanceleaf goldenweed, shrubby cinquefoil, and purple milkvetch. The average annual production of air-dry vegetation is about 1200 pounds per acre on the Gladlow soil and about 900 pounds on the Ruko soil.

Soil Management Implications

This unit is used for wildlife habitat and livestock grazing.

The mass movement potential is rated low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the shrink-swell potential, the shallow depth to bedrock, and the low strength. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Stock water development and fencing will help to improve livestock distribution and range quality. More uniform use of rangeland is aided by properly locating salt and by herding. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that moisture in the soil will be adequate for the establishment of seedlings the next spring.

If this map unit is used for recreational development, the main limitations are the shallow depth to bedrock in the Ruko soil, rock outcrops, the hazard of erosion, and slopes that are over 8 percent. Erosion and sedimentation can be controlled and the beauty of the area enhanced by maintenance of adequate plant cover.

The Gladlow soil is in capability subclass 4e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated. The Ruko soil is in capability subclass 6s, nonirrigated.

705—Helmet clay loam, 1 to 15 percent slopes

Map Unit Description

This very deep, well drained soil is on footslopes and toeslopes of mountains. The elevation is 9,000 to 10,500 feet. The average annual precipitation is 30 to 40 inches, the average annual air temperature is 34 to 40 degrees F., and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Helmet clay loam

The Helmet soil formed in slope alluvium derived dominantly from diorite, rhyolite, and shale. Typically, the surface is covered with a mat of partly decomposed leaves, needles, and twigs, about 2 inches thick. The surface layer is dark brown clay loam about 2 inches thick. The upper part of the subsoil is grayish brown clay loam about 9

inches thick; the next part is light brownish gray clay about 8 inches thick; and the lower part is grayish brown and yellowish brown clay about 7 inches thick. The upper 18 inches of the underlying material are grayish brown and yellowish brown silty clay, and the lower part consists of grayish brown silty clay loam to a depth of 62 inches or more.

The permeability of the Helmet soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 5 percent Nordicol very stony loam on steeper slopes; about 5 percent Mancos loam on ridges; 5 percent Teedown loam on toeslopes; and 5 percent Skutum loam on toeslopes. Teedown and Skutum have thick dark colored surface layers. Nordicol soils have more than 35 percent rock fragments in the profile. Mancos soils are moderately deep.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus*. Some *Abies lasiocarpa-Picea engelmannii/Carex geyeri* may also occur on this soil. The native vegetation on this unit consists mainly of quaking aspen, mountain snowberry, and mountain brome. Other important plants that characterize this unit are Englemann's spruce, subalpine fir, white fir, Rocky Mountain Douglas-fir, Kentucky bluegrass, Nevada pea, elderberry, mountain ninebark, gooseberry currant, thimbleberry, Fendler's meadow-rue, and elk sedge. The average annual understory production of air-dry vegetation is about 1,000 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for quaking aspen is 84 on the Helmet soil. It can produce about 52 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 110 years old.

The mass movement potential is rated low for this unit because of the slope.

The Helmet soil is well suited to the production of quaking aspen. Timber productivity is estimated to be high. The main concerns in producing and harvesting timber are reforestation after harvest if trees other than aspen are to be grown. Conventional methods of harvesting timber generally can be used, but their use may be limited when the soil is wet. Careful consideration of road systems and harvesting methods should be made to minimize erosion. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvesting, reforestation must be managed to reduce competition from undesirable understory plants. Clayey soils can make tree planting difficult. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce and lodgepole pine. Quaking aspen will generally regenerate from roots after harvest.

The main limitations to the building of unsurfaced roads on this soil are the low strength and the high shrink-swell potential. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Stock water development and fencing will help to improve livestock distribution and the production of understory vegetation.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the slopes that are over 8 percent and the slow permeability. Camp areas and picnic areas can be developed on lower slopes. Paths and trails can be developed.

This map unit is in capability subclass 4e, nonirrigated.

706—Narraguinnep clay loam, 5 to 15 percent slopes

Map Unit Description

This very deep well drained soil is on alluvial fans, fan remnants, and mesas. The elevation is 7,600 to 8,500 feet. The average annual precipitation is 18 to 25 inches, the average annual air temperature is 40 to 43 degrees F., and the average frost-free period is 70 to 90 days. The moisture and temperature regimes are ustic and frigid, respectively.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not to affect the use or management of the unit. These include Bradfield clay loam and Gladlow clay loam. These similar soils make up about 10 percent of the total acreage; the percentage varies from one area to another.

Brief Soil Description

Narraguinnep clay loam

The Narraguinnep soil formed in alluvium and slope alluvium derived dominantly from shale. Typically, the surface layer is dark grayish brown clay loam about 6 inches thick. The upper 17 inches of the subsoil are grayish brown clay, and the lower 7 inches are grayish brown clay loam. The substratum is pale brown clay to a depth of 60 inches or more. The similar Bradfield soils have deep cracks and slickensides. Gladlow soils have light colored surface layers.

The permeability of the Narraguinnep soil is slow. The available water capacity is high. The hydrologic group is D. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 9 percent soils with shale above 40 inches; also included is about 1 percent of soils that have more cobbles and gravel in the profile and on the surface than is typical for the map unit. Included soils make up about 10 percent of the total acreage; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Quercus gambelii/Symphoricarpos oreophilus*. The native vegetation on this unit consists mainly of Gambel oak, mountain snowberry, Arizona fescue, mountain brome, bluegrass, western wheatgrass, slender wheatgrass, and basin big sagebrush. Other important plants that characterize this unit are needleandthread, elk sedge, Saskatoon serviceberry, and mountain muhly. The average annual production of air-dry vegetation is about 2,000 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the low strength and the shrink-swell potential. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and range productivity. More uniform use of rangeland is aided by properly locating salt and by herding.

If the condition of the range deteriorates, shrub species increase. Brush management improves areas of range that are producing more woody shrubs than were present in the natural plant community. Areas where brush is managed by prescribed burning, chemical or mechanical methods may be subject to a greater hazard of erosion. If the range vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the clayey soils and the shrubs. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the slopes that are over 8 percent and the slow permeability. Camp areas and picnic areas can be developed on lower slopes. Paths and trails can be developed.

This map unit is in capability subclass 4e, nonirrigated.

707—Teedown-Nordicol complex, 5 to 15 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes and mesas. The elevation is 8,500 to 10,000 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is 35 to 40 degrees F., and the average frost-free period is 50 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 50 percent Teedown loam, 35 percent Nordicol very cobbly loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Teedown loam

The Teedown soil formed in slope alluvium derived dominantly from shale and quartz diorite. Typically, the surface layer is dark gray loam about 20 inches thick. The upper 8 inches of the subsoil are grayish brown clay, and the lower 10 inches are light yellowish brown clay. The substratum is grayish brown stony clay to a depth of 60 inches or more.

The permeability of the Teedown soil is slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Nordicol very cobbly loam

The Nordicol soil formed in slope alluvium derived dominantly from sandstone and quartz diorite. Typically, the surface is covered with a mat of organic material about 3 inches thick. The surface layer is very dark grayish brown very cobbly loam about 15 inches thick. The subsurface layer is very pale brown very cobbly sandy clay loam about 14 inches thick. The subsoil is pale brown extremely cobbly sandy clay loam to a depth of 63 inches or more.

The permeability of the Nordicol soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Clayburn loam in drainageways; 5 percent Frisco loam on hillslopes; small areas of soil with thinner dark surface layers on breaks; small areas of Cryaquolls in depressions; and small areas that are underlain by shale at depths of 40 to 60 inches on ridges and breaks. Clayburn soils have thick dark surface layers and fine-loamy subsoils. Frisco soils have light colored surface layers and more than 35 percent rock fragments in the profile. Cryaquolls are wet. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus/Carex geyeri*. The native vegetation on this unit consists mainly of quaking aspen, mountain snowberry, Thurber's fescue, Kentucky bluegrass, and mountain brome. Other important plants that characterize this unit are Columbia needlegrass, slender wheatgrass, elk sedge, Nevada pea, common chokecherry, and purple reedgrass. The average annual understory production of air-dry vegetation is about 3,000 pounds per acre on the Teedown soil and about 2,000 pounds per acre on the Nordicol soil.

Soil Management Implications

This map unit is mainly used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for quaking aspen is 80 on the Teedown soil. It can produce about 48 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope.

The main concerns in producing and harvesting timber are reforestation after harvest. Timber productivity is estimated to be high. Conventional methods of harvesting timber generally can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitations to reforestation on the Nordicol soil are the content of cobbles and stones in the profile. Large stones limit rooting space and soil moisture, and interfere with planting operations. Competing vegetation can be controlled by properly preparing the site and by spraying, cutting, or burning to eliminate unwanted weeds, brush, or trees. Quaking aspen will normally regenerate from roots after harvest. Other trees suited to this unit are subalpine fir and Englemann's spruce.

The main limitations to building unsurfaced roads on this unit are the content of cobbles and stones in the Nordicol soil, and the high clay content and low strength of the Teedown soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range and understory areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory vegetation. If the condition of the range or understory deteriorates, snowberry tends to increase.

Wildlife such as elk, mule deer, bear, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the content of stones on the Nordicol soil, the slow permeability of the Teedown soil, and slopes that are over 8 percent. Lower slopes are suited to recreational development. Paths and trails can be developed.

The Teedown soil is in capability subclass 6c, nonirrigated. The Nordicol soil is in capability subclass 7s, nonirrigated.

708—Helmet clay loam, 30 to 60 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 9,000 to 10,500 feet. The average annual precipitation is 30 to 40 inches, the average annual air temperature is 34 to 40 degrees F., and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Helmet clay loam

The Helmet soil formed in slope alluvium derived dominantly from diorite, rhyolite and shale. Typically, the surface is covered with a mat of partly decomposed leaves, needles, and twigs about 2 inches thick. The surface layer is dark brown clay loam about 2 inches thick. The upper part of the subsoil is grayish brown clay loam about 9 inches thick; the next part is light brownish gray clay about 8 inches thick; and the lower part is grayish brown and yellowish brown clay about 7 inches thick. The upper 18 inches of the underlying material are grayish brown and yellowish brown silty clay, and the lower part consists of grayish brown silty clay loam to a depth of 62 inches or more.

The permeability of the Helmet soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 5 percent Nordicol very stony loam on mountain slopes; about 5 percent Mancos loam on ridges; 5 percent Teedown loam on toeslopes; and 5 percent Skutum loam on toeslopes. Teedown and Skutum have thick dark colored surface layers. Nordicol soils have more than 35 percent rock fragments in the profile. Mancos soils are moderately deep.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Carex geyeri*. Some *Populus tremuloides/Symphoricarpos oreophilus* also occurs. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, quaking aspen, mountain snowberry, mountain brome, Kentucky bluegrass, and elk

sedge. Other important plants that characterize this unit are white fir, Rocky Mountain Douglas-fir, elderberry, mountain ninebark, gooseberry currant, thimbleberry, Fendler's meadow-rue, and Nevada pea. The average annual understory production of air-dry vegetation is about 1,000 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for Englemann's spruce is 96 on the Helmet soil. It can produce about 100 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 90 years old.

The mass movement potential is rated high for this unit because of the steep slopes and the clayey textures.

The Helmet soil is well suited to the production of Englemann's spruce. Timber productivity is estimated to be high. The main concerns in producing and harvesting timber are reforestation after harvest and preventing erosion along roads and other places where vegetation has been removed. Conventional methods of harvesting timber generally can be used, but their use may be limited when the soil is wet. Careful consideration of road systems and harvesting methods should be made to minimize erosion. The slopes limit the kind of equipment that can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce and lodgepole pine.

The main limitations to building unsurfaced roads on this soil are the low strength, the high mass movement potential, and the slope. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Stock water development and fencing will help to improve livestock distribution and the production of understory vegetation. The steep slopes limit access by livestock and result in overgrazing of less sloping areas.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes and the slow permeability. The slopes limit use of the unit mainly to a few paths and trails, which should extend across the slope. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

709—Teedown loam, 0 to 20 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes and mesas. The elevation is 9,000 to 10,500 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is 35 to 40 degrees F., and the average frost-free

period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Teedown loam

The Teedown soil formed in slope alluvium derived dominantly from shale and quartz diorite. Typically, the surface layer is dark gray loam about 20 inches thick. The upper 8 inches of the subsoil are grayish brown clay, and the lower 10 inches is light yellowish brown clay. The substratum is grayish brown stony clay to a depth of 60 inches or more.

The permeability of the Teedown soil is slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 5 percent Nordicol very stony loam on ridges; 5 percent Helmet loam on hillslopes; and 5 percent Clayburn loam on toeslopes and in drainageways. Nordicol soils have more than 35 percent rock fragments in the profile. Helmet soils have thinner dark colored surface layers. Clayburn soils have thick dark surface layers and fine-loamy subsoils.

Vegetation

The dominant plant association is *Festuca thurberi/Vicia americana-Lathyrus leucanthus*. Some *Populus tremuloides/Symphoricarpos oreophilus* also occurs in quaking aspen groves. The native vegetation on this unit consists mainly of Thurber's fescue, Columbia needlegrass, mountain brome, and mountain snowberry. Other important plants that characterize this unit are elk sedge, Kentucky bluegrass, and patches of quaking aspen. The average annual production of air-dry vegetation is about 3,000 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the high shrink-swell potential and the low strength. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

This unit is well suited to livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and range condition. More uniform use of rangeland is aided by properly locating salt and by herding. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are slopes that are over 8 percent and the slow permeability. Steeper slopes mainly are suited to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6c, nonirrigated.

710—Sili-Zigzag complex, 5 to 15 percent slopes

Map Unit Description

This map unit is a complex of very deep and shallow, well drained soils on alluvial fans, hills, and toeslopes of hills. The elevation is 6,500 to 7,500 feet. The average annual precipitation is 13 to 16 inches, the average annual air temperature is 47 to 52 degrees F., and the average frost-free period is 100 to 120 days. The moisture and temperature regimes are aridic-ustic and mesic, respectively.

This map unit consists of 50 percent Sili clay loam, 30 percent Zigzag gravelly clay loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Sili clay loam

The Sili soil is very deep. It formed in slope alluvium derived from shale and sandstone. Typically, the surface layer is grayish brown clay loam about 3 inches thick. The upper 12 inches of the subsoil are grayish brown clay loam, and the lower 10 inches are light brownish gray clay loam. The substratum is light brownish gray clay loam to a depth of 60 inches or more.

The permeability of the Sili soil is moderately slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. Gullies occur in some drainageways. The potential of shrink-swell is moderate.

Zigzag gravelly clay loam

The Zigzag soil is shallow. It formed in residuum derived dominantly from shale and sandstone. Typically, the surface layer is pale brown gravelly clay loam about 4 inches thick. The underlying material is pale brown clay about 8 inches thick over shale bedrock; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Zigzag soil is slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 5 percent soils that have more than 35 percent rock fragments in the profile on hillslopes; 5 percent Bodot silty clay loam on mesas and hills; 10 percent Lillings silty clay loam in drainageways; and small areas of Rock outcrop on breaks. Bodot soils are moderately deep over bedrock. Lillings soils do not have subsoils and have stratification throughout the control section. Included areas make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Artemisia tridentata/Elytrigia smithii* in open areas on the Sili soil and *Pinus edulis-Juniperus osteosperma/Poa fendleriana* on the Zigzag soil. The native vegetation on this unit consists mainly of twoneedle pinyon, Utah juniper, Gambel oak, and basin big sagebrush. Other important plants that characterize this unit are western wheatgrass, Indian ricegrass, muttongrass, Utah serviceberry, fourwing saltbush, antelope bitterbrush, true mountain mahogany, cliff fendlerbush, slender wheatgrass, prairie Junegrass, and bottlebrush squirreltail. The average annual production of air-dry vegetation is about 900 pounds per acre on the Sili soil and 400 pounds per acre on the Zigzag soil.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope of the Sili soil and depth to bedrock of the Zigzag soil.

The main limitations to the building of unsurfaced roads on this unit are the low soil strength of the Sili soil and the shallow depth to bedrock of the Zigzag soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

Removal of pinyon and juniper increases the production of understory vegetation. Range seeding should be done in conjunction with removal of overstory.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and range quality. More uniform use of rangeland is aided by properly locating salt and by herding. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings in the spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the depth to bedrock in the Zigzag soil, the hazard of erosion, and slopes that are over 8 percent. Paths and trails can be developed. Drainage should be provided for paths and trails. Erosion and sedimentation can be controlled and the beauty of the area enhanced by maintenance of adequate plant cover.

The Sili soil is in capability subclass 4e, nonirrigated. The Zigzag soil is in capability subclass 6s, nonirrigated.

711—Sili clay loam, 5 to 15 percent slopes

Map Unit Description

This very deep, well drained soil is on alluvial fans and toeslopes of shale hills. The elevation is 6,500 to 7,500 feet. The average annual precipitation is 13 to 16 inches, the average annual air temperature is 47 to 52 degrees F., and the average frost-free period is 100 to 120 days. The moisture and temperature regimes are aridic-ustic and mesic, respectively.

Brief Soil Description

Sili clay loam

The Sili soil formed in alluvium and slope alluvium derived from shale and sandstone. Typically, the surface layer is grayish brown clay loam about 3 inches thick. The upper 12 inches of the subsoil are grayish brown clay loam; the lower 10 inches of the subsoil are light brownish gray clay loam. The substratum is light brownish gray clay loam to a depth of 60 inches or more.

The permeability of the Sili soil is moderately slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. Gullies occur in many drainageways and on some fans. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 5 percent Zigzag clay loam and 5 percent Bodot silty clay loam on ridges; and 5 percent Lillings silty clay loam on flood plains and in drainageways. Zigzag soils are shallow. Bodot soils are moderately deep. Lillings soils do not have subsoils and have stratification throughout.

Vegetation

The dominant plant association is *Artemisia tridentata*/*Elytrigia smithii*. Some *Artemisia tridentata*/*Oryzopsis hymenoides* occurs on similar landscapes. A few small areas with trees have *Pinus edulis*-*Juniperus osteosperma*/*Artemisia tridentata*. The native vegetation on this unit consists mainly of basin big sagebrush, Indian ricegrass, and western wheatgrass (Fig. 16). Other important plants that characterize this unit are fourwing saltbush, cliff fendlerbush, bottlebrush squirreltail, prairie Junegrass, and muttongrass. Small areas have scattered twoneedle pinyon and Utah juniper. The average annual production of air-dry vegetation is about 900 pounds per acre.



Figure 16.—Sili clay loam, 5 to 15 percent slopes, is on alluvial fans and toe slopes below shale hills. The range site is Clayey Valley. The shrubs are big sagebrush.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

The main limitation to the building of unsurfaced roads on Sili soils is the low strength. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition.

Stock water development and fencing will help to improve livestock distribution and range quality. More uniform use of rangeland is aided by properly locating salt and by herding.

Removal of pinyon and juniper increases the production of understory forage. Range seeding should be done in conjunction with removal of the overstory. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitation is the presence of slopes that are over 8 percent. Paths and trails can be developed. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 4e, nonirrigated.

714—Helmet loam, 15 to 30 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 9,000 to 10,500 feet. The average annual precipitation is 30 to 40 inches, the average annual air temperature is 34 to 40 degrees F., and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Helmet loam

The Helmet soil formed in slope alluvium derived dominantly from diorite, rhyolite and shale. Typically, the surface is covered with a mat of partly decomposed leaves, needles, and twigs about 2 inches thick. The surface layer is dark brown loam about 2 inches thick. The upper part of the subsoil is grayish brown clay loam about 9 inches thick; the next part is light brownish gray clay about 8 inches thick; and the lower part is grayish brown and yellowish brown clay about 7 inches thick. The upper 18 inches of the underlying material are grayish brown and yellowish brown silty clay, and the lower part consists of grayish brown silty clay loam to a depth of 62 inches or more.

The permeability of the Helmet soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 5 percent Nordicol very stony loam on mountain slopes; about 5 percent Mancos loam on ridges; 5 percent Teedown loam on footslopes; and 5 percent Skutum loam on footslopes. Teedown and Skutum soils have thick dark colored surface layers. Nordicol soils have more than 35 percent rock fragments in the profile. Mancos soils are moderately deep. Included areas make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa*-*Picea engelmannii*/*Carex geyeri*. Some *Populus tremuloides*/*Symphoricarpos oreophilus* also occurs. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, white fir, Rocky Mountain Douglas-fir, quaking aspen, and elk sedge. Other important

plants that characterize this unit are mountain snowberry, mountain brome, Kentucky bluegrass, elderberry, mountain ninebark, gooseberry currant, thimbleberry, Fendler's meadow-rue, and Nevada pea. The average annual understory production of air-dry vegetation is about 1,000 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for Englemann's spruce is 96 on the Helmet soil. It can produce about 100 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 90 years old.

The mass movement potential is rated moderate for this unit because of clayey textures and the slope.

The Helmet soil is well suited to the production of Englemann's spruce. Timber productivity is estimated to be high. The main concerns in producing and harvesting timber are reforestation and preventing erosion along roads and other places where vegetation has been removed. Conventional methods of harvesting timber generally can be used, but their use may be limited when the soil is wet. Careful consideration of road systems and harvesting methods should be made to minimize erosion. Tree harvesting may be restricted during periods of high snow accumulation, snow melt or high rainfall.

After harvesting, reforestation must be managed to reduce competition from undesirable understory plants. Planting nursery stock will hasten reforestation. Clayey textures can make tree planting difficult. Among the trees that are suitable for planting are Englemann's spruce, Rocky Mountain Douglas-fir, and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest.

The main limitations to the building of unsurfaced roads on this soil are the low strength and the high shrink-swell potential. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Stock water development and fencing will help to improve livestock distribution and the production of understory vegetation.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the slope and the slow permeability. The slope limits most of the areas to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

718—Naraguinnep-Gladlow complex, 5 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep and well drained soils on mountain slopes. The elevation is 7,600 to 8,500 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is 40 to 43 degrees F., and the average frost-free period is 70 to 90 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 50 percent Narraguinne clay loam, 40 percent Gladlow clay loam, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Narraguinne clay loam

The Narraguinne soil formed in slope alluvium derived dominantly from shale. Typically, the surface layer is dark grayish brown clay loam about 6 inches thick. The upper 17 inches of the subsoil are grayish brown clay, and the lower 7 inches are grayish brown clay loam. The substratum is pale brown clay to a depth of 60 inches or more.

The permeability of the Narraguinne soil is slow. The available water capacity is high. The hydrologic group is D. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is high.

Gladlow clay loam

The Gladlow soil formed in slope alluvium and colluvium derived dominantly from shale. Typically, the surface layer is grayish brown clay loam about 5 inches thick. The upper 19 inches of the subsoil are brown silty clay, and the lower 7 inches are light brownish gray silty clay. The substratum is variegated colors of gray and pale brown clay loam to a depth of 60 inches or more.

The permeability of the Gladlow soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 5 percent soils with more cobbles than the normal soils and about 5 percent soils with shale bedrock above 40 inches, both on mountain slopes.

Vegetation

The dominant plant association is *Quercus gambelii*/*Symphoricarpos oreophilus*. The native vegetation on this unit consists mainly of Gambel oak, mountain snowberry, western wheatgrass, Arizona fescue, and basin big sagebrush. Other important plants that characterize this unit are Letterman's needlegrass, bluegrass, muttongrass, elk sedge, Saskatoon serviceberry, and mountain muhly. The average annual production of air-dry vegetation is about 2,000 pounds per acre on the Narraguinne soil and about 2,100 pounds per acre on the Gladlow soil.

Soil Management Implications

This unit is used for wildlife habitat and cattle grazing.

The mass movement potential is rated high for this unit because of the slopes, clayey textures and underlying shale, especially on slopes over 15 percent.

The main limitations to the building of unsurfaced roads on this unit are the low strength, the shrink-swell potential, and the slope.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range vegetation.

If the condition of the range deteriorates, shrub species increase. Areas where brush is managed by prescribed burning, chemical or mechanical methods may be subject to a greater hazard of erosion. Range seeding should be done in conjunction

with removal of the brush if needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings in the spring. The main limitations for seeding are the slopes and the shrubs.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are slopes that are over 8 percent and the slow permeability. The slopes limit the use of most areas of this unit to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

720—Zigzag-Rock outcrop complex, 30 to 80 percent slopes

Map Unit Description

This map unit is a complex of shallow, well drained soils on hills and Rock outcrop on escarpments. The elevation is 6,500 to 7,500 feet. The average annual precipitation is 13 to 16 inches, the average annual air temperature is 46 to 50 degrees F., and the average frost-free period is 100 to 120 days. The moisture regime is aridic-ustic and the temperature regime is mesic.

This map unit consists of 45 percent Zigzag gravelly clay loam, 35 percent Rock outcrop, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Zigzag gravelly clay loam

The Zigzag soil formed in residuum derived from shale and sandstone. Typically, the surface layer is pale brown gravelly clay loam about 4 inches thick. The underlying material is pale brown clay about 8 inches thick over shale bedrock. The depth to bedrock ranges from 10 to 20 inches.

The permeability of the Zigzag soil is slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Rock outcrop

Rock outcrop consists of shale and sandstone escarpments and outcrops.

Contrasting Inclusions

Included in this unit are about 10 percent Sili clay loam on toeslopes; 9 percent Bodot silty clay loam on the less sloping hills and ridges; and small areas of soils that have a very stony surface. Sili soils are very deep. Bodot soils are moderately deep. Included areas make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus edulis-Juniperus osteosperma/Poa fendleriana*. Some *Pinus edulis-Juniperus osteosperma/Artemisia tridentata* may also occur on the same landform. The native vegetation on this unit consists mainly of twoneedle pinyon, Utah juniper, Gambel oak, and basin big sagebrush (Fig. 17). Other important plants that characterize this unit are muttongrass, Indian ricegrass, western wheatgrass, true mountain mahogany, snowberry, cliff fendlerbush, Utah



Figure 17.—Zigzag-Rock outcrop complex, 30 to 80 percent slopes, has sparse stands of pinyon and juniper trees, and is used for wildlife habitat and livestock grazing.

serviceberry, and antelope bitterbrush. The average annual production of air-dry vegetation is about 400 pounds per acre on the Zigzag soil.

Soil Management Implications

This unit is used for wildlife habitat and livestock grazing.

The mass movement potential is rated high for this unit because of steep slopes and the potential for rock fall.

The main limitations to the building of unsurfaced roads on this soil are the steep slopes, rock outcrops, and the shallow depth to bedrock.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and range production. More uniform use of rangeland is aided by properly locating salt. The slope limits access by livestock and results in overgrazing of the less sloping areas. Mechanical treatment practices are not practical, because the surface is stony and the slopes are steep. The main limitations for seeding are the shallow soil, steep slopes, and rock outcrops.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the depth to bedrock, the rock outcrops, steep slopes, and the hazard of erosion. The slopes limit use of the map unit mainly to a few paths and trails, which should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Zigzag soil is in capability subclass 7e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

723—Zigzag-Rock outcrop complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of shallow, well drained soils and Rock outcrop on shale hills and ridges. The elevation is 6,500 to 7,500 feet. The average annual precipitation is 13 to 16 inches, the average annual air temperature is 46 to 50 degrees F., and the average frost-free period is 100 to 120 days. The moisture regime is aridic-ustic and the temperature regime is mesic.

This map unit consists of 50 percent Zigzag gravelly clay loam, 40 percent Rock outcrop, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Zigzag gravelly clay loam

The Zigzag soil formed in residuum derived from shale and sandstone. Typically, the surface layer is pale brown gravelly clay loam about 4 inches thick. The underlying layer is pale brown clay about 8 inches thick over shale bedrock. The depth to bedrock ranges from 10 to 20 inches.

The permeability of the Zigzag soil is slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Rock outcrop

Rock outcrop consists of shale and sandstone outcrops, which occur on the steeper slopes and breaks.

Contrasting Inclusions

Included in this soil is about 5 percent Sili clay loam on alluvial fans, 4 percent Bodot silty clay loam on gently sloping hills and ridges, and small areas of soils that are very cobbly on the surface. Sili soils are very deep. Bodot soils are moderately deep. Included areas make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus edulis-Juniperus osteosperma/Artemisia tridentata*. Some *Pinus edulis-Juniperus osteosperma/Poa fendleriana* may also occur on the same landscape. The native vegetation on this unit consists mainly of twoneedle pinyon, Utah juniper, basin big sagebrush, true mountain mahogany, and Gambel oak. Other important plants that characterize this unit are muttongrass, western wheatgrass, Indian ricegrass, snowberry, cliff fendlerbush, Utah serviceberry, and antelope bitterbrush. The average annual production of air-dry vegetation is about 400 pounds per acre on the Zigzag soil.

Soil Management Implications

This unit is used for wildlife habitat and livestock grazing.

The mass movement potential is rated low for this unit because of the slope and the shallow depth to bedrock.

The main limitations to the building of unsurfaced roads on this unit are the rock outcrops and the shallow depth to bedrock.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and range production. More uniform use of rangeland is aided by properly locating salt. Mechanical treatment practices are not practical because of rock outcrops. If the range vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the shallow soil, moderately steep slopes, and rock outcrops. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the depth to bedrock, rock outcrops, and the slope. The slope limits use of the map unit mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Zigzag soil is in capability subclass 6e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

725—Shawa loam, 20 to 30 percent slopes

Map Unit Description

This very deep, well drained soil is on hills. The elevation is 7,100 to 8,200 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 40 to 46 degrees F, and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not affect the use and management of the unit. These include Hesperus loam on low terraces and in drainageways. These similar soils make up about 5 percent of the total acreage; the percentage varies from one area to another.

Brief Soil Description

Shawa loam

The Shawa soil formed in slope alluvium derived dominantly from sandstone and shale. Typically, the surface layer is brown loam 19 inches thick. The upper 19 inches of the subsoil are brown clay loam, and the lower part consists of brown cobbly clay loam to a depth of 60 inches or more.

The permeability of the Shawa soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Fughes loam and about 5 percent Pagoda clay loam, both in drainageways. Fughes and Pagoda soils have fine textured subsoils.

Vegetation

The dominant plant associations are *Festuca arizonica*/*Muhlenbergia montana* and *Quercus gambelii*/*Symphoricarpos oreophilus*. The native vegetation consists of

Gamble's oak, common snowberry, Arizona fescue, mountain muhly, needleandthread, mountain brome, bluegrass, western wheatgrass, Indian ricegrass and basin big sagebrush. The average annual production of air dry vegetation is about 1,300 pounds per acre.

Soil Management Implications

This unit is used mainly for livestock grazing and wildlife habitat.

The mass movement potential is rated moderate for this unit.

The main limitation to building of unsurfaced roads on the Shawa soil is the low strength.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of vegetation for grazing. More uniform distribution of livestock is aided by properly locating salt and by herding. If the condition of the range deteriorates, Gambel oak increases. If the range is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitation is the slope, which limits use of the unit mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

727—Teedown-Nordicol complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes and mesas. The elevation is 8,500 to 11,000 feet. The average annual precipitation is 25 to 40 inches, the average annual air temperature is 35 to 40 degrees F., and the average frost-free period is 50 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 50 percent Teedown loam, 35 percent Nordicol very cobbly loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Teedown loam

The Teedown soil formed in slope alluvium derived dominantly from weathered shale and quartz diorite. Typically, the surface layer is dark gray loam about 20 inches thick. The upper 8 inches of the subsoil are grayish brown clay, and the lower 10 inches are light yellowish brown clay. The substratum is grayish brown stony clay to a depth of 60 inches or more.

The permeability of the Teedown soil is slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Nordicol very cobbly loam

The Nordicol soil formed in slope alluvium derived dominantly from sandstone and quartz diorite. Typically, the surface is covered with a mat of organic material about 3 inches thick. The surface layer is very dark grayish brown very cobbly loam about 15 inches thick. The subsurface layer is very pale brown very cobbly sandy clay loam about 14 inches thick. The subsoil is pale brown extremely cobbly sandy clay loam to a depth of 63 inches or more.

The permeability of the Nordicol soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Clayburn loam on toeslopes; 5 percent Frisco stony loam on mountain slopes; 4 percent Sessions loam on structural benches; and small areas of Cryaquolls in depressions. Clayburn soils have thick dark colored surface layers and fine-loamy subsoils. Frisco soils have light colored surface layers and more than 35 percent rock fragments in the profile. Sessions soils have dark colored surface layers less than 16 inches thick and less than 35 percent rock fragments in the profile. Cryaquolls are wet. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus/Carex geyeri*. The native vegetation on this unit consists mainly of quaking aspen, mountain snowberry, Thurber's fescue, mountain brome, and elk sedge. Other important plants that characterize this unit are Columbia needlegrass, Kentucky bluegrass, slender wheatgrass, Nevada pea, common chokecherry, purple reedgrass, and Gambel oak. The average annual understory production of air-dry vegetation is about 3,000 pounds per acre on the Teedown soil and about 2,000 pounds per acre on the Nordicol soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for quaking aspen is 82 on the Nordicol soil. It can produce about 50 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope.

This unit is well suited to the production of quaking aspen. The main concerns in producing and harvesting timber are reforestation after harvest if trees other than quaking aspen are to be grown. Timber productivity is estimated to be high. Conventional methods of harvesting timber can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitations to reforestation on the Nordicol soil are the content of cobbles and stones in the profile. Large stones limit rooting space and soil moisture, and interfere with planting operations. Competing vegetation can be controlled by properly preparing the site and by spraying, cutting, or burning to eliminate unwanted weeds, brush, or trees. Quaking aspen will generally regenerate from roots after harvest. Other trees suited to this unit are white fir, subalpine fir, and Englemann's spruce.

The main limitations to building unsurfaced roads on this unit are the content of cobbles and stones in the Nordicol soil, and high clay content and low strength of the Teedown soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory vegetation. If the condition of the range deteriorates, snowberry tends to increase.

Wildlife such as elk, mule deer, bear, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the slope, the slow permeability in the Teedown soil, and the content of stones in the Nordicol soil. The slope limits development of most areas of the unit to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Teedown soil is in capability subclass 6e, nonirrigated. The Nordicol soil is in capability subclass 7s, nonirrigated.

730—Baird Hollow-Nordicol-Ryman complex, 5 to 40 percent slopes

Map Unit Description

This map unit is a complex of very deep well drained soils on mountain slopes and structural benches. The elevation is 10,000 to 11,000 feet. The average annual precipitation is 25 to 35 inches, the average annual air temperature is 35 to 38 degrees F., and the average frost-free period is 40 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 35 percent Baird Hollow loam, 30 percent Nordicol very cobbly loam, 25 percent Ryman silty clay loam, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Baird Hollow loam

The Baird Hollow soil formed in slope alluvium derived from rhyolite and sandstone. Typically, the surface is covered with a mat of quaking aspen leaves and other partly decayed material about 2 inches thick. The surface layer is dark grayish brown loam about 7 inches thick. The next layer is brown loam about 11 inches thick. The upper 9 inches of the subsoil are light brownish gray very cobbly sandy clay loam and brown very cobbly clay loam. The lower part of the subsoil is brown very cobbly clay loam extending to 62 inches or more.

The permeability of the Baird Hollow soil is slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Nordicol very cobbly loam

The Nordicol soil formed in colluvium and slope alluvium derived dominantly from sandstone and volcanic rocks. Typically, the surface is covered with a mat of partially decayed leaves, needles, and roots about 1 inch thick. The surface layer is dark grayish brown very cobbly loam about 19 inches thick. The subsurface layer is light brown very stony sandy loam about 8 inches thick. The subsoil is brown very stony

sandy clay loam about 24 inches thick. The substratum is light yellowish brown extremely stony sandy loam to a depth of 61 inches or more.

The permeability of the Nordicol soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Ryman silty clay loam

The Ryman soil formed in slope alluvium and residuum derived dominantly from shale and sandstone. Typically, the surface layer is grayish brown silty clay loam about 19 inches thick. The upper 17 inches of the substratum are variable yellowish brown and light brownish gray clay. The lower part of the substratum is variable brownish yellow and light brownish gray cobbly clay loam to a depth of 60 inches or more.

The permeability of the Ryman soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this map unit are 5 percent Quazar very cobbly loam on toeslopes, and 5 percent Frisco cobbly loam on mountain slopes. Quazar soils have dark colored surface layers and more than 35 percent rock fragments in the texture control section. Frisco soils have light colored surface layers and more than 35 percent rock fragments in the texture control section.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus*. Some *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus* also occur. The native vegetation on this unit consists mainly of quaking aspen, common snowberry, Thurber's fescue, and mountain brome. There are minor amounts of Englemann's spruce, subalpine fir, Rocky Mountain Douglas-fir, and white fir. Other important plants that characterize this unit are Kentucky bluegrass, Fendler's meadow-rue, Nevada pea, slender wheatgrass, purple reedgrass, elk sedge, twinberry honeysuckle, and Richardson's geranium. The average annual production of understory vegetation is about 2,000 pounds per acre on all three soils.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for quaking aspen is 65 on the Baird Hollow soil. It can produce about 36 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 80 years old.

The mass movement potential is rated low for this unit because of the slope and the high content of rock fragments.

The main concerns in producing and harvesting timber are road construction and reforestation. Conventional methods of harvesting can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

This unit is well suited to timber production. Large stones limit rooting space and soil moisture, and interfere with planting operations. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest.

The main limitations to the building of unsurfaced roads on this unit are the content of cobbles and stones in the soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to

rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of understory vegetation. More uniform use of range or understory vegetation is aided by properly locating salt and by herding.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the slopes that are over 8 percent, the slow permeability, and the content of stones in the Nordicol soil. The slopes limit development of most areas of the unit to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Baird Hollow and Ryman soils are in capability subclass 6e, nonirrigated. The Nordicol soil is in capability subclass 7s, nonirrigated.

731—Ryman-Adel complex, 1 to 15 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mesas. The elevation is 8,000 to 10,000 feet. The average annual precipitation is 25 to 35 inches, the average annual air temperature is 35 to 40 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 60 percent Ryman silty clay loam, 30 percent Adel loam, and 10 percent included soils. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not to affect the use or management of the unit. These include Clayburn loam. These similar soils make up about 5 percent of the total acreage; the percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Ryman silty clay loam

The Ryman soil formed in slope alluvium and residuum derived dominantly from shale and sandstone. Typically, the surface layer is grayish brown silty clay loam about 19 inches thick. The upper 17 inches of the substratum are variable yellowish brown and light brownish gray clay. The lower part of the substratum is variable brownish yellow and light brownish gray cobbly clay loam to a depth of 60 inches or more.

The permeability of the Ryman soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Adel loam

The Adel soil formed in slope alluvium derived from mixed sources. Typically, the surface layer is dark grayish brown loam about 14 inches thick. The next layer is dark

grayish brown loam about 22 inches thick. The substratum is brown clay loam to a depth of 60 inches or more.

The permeability of the Adel soil is moderate. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are small areas of Bucklon loam on ridges and small areas of soils on mesas that have more than 35 percent rock fragments in the profile and have sandstone bedrock between 20 and 40 inches. Bucklon soils are shallow over shale. These inclusions make up about 5 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus*. The native vegetation on this unit consists mainly of quaking aspen, common snowberry, Thurber's fescue, and mountain brome. Other important plants that characterize this unit are western wheatgrass, slender wheatgrass, Nevada pea, Fendler's meadow-rue, Kentucky bluegrass, and a few subalpine fir. The average annual understory production of air-dry vegetation is about 2,000 pounds per acre on the Ryman soil and about 3,000 pounds per acre on the Adel soil.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for quaking aspen is 67 on the Ryman soil. It can produce about 37 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope.

This unit is well suited to the production of aspen. The main concern in producing and harvesting timber is reforestation. Conventional methods of harvesting timber can be used. Grazing in harvested areas should be deferred for at least 2 years to insure development of sufficient plant cover to protect the soil from erosion.

After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants if trees other than quaking aspen are to be grown. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce, white fir, and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest.

The main limitations to building unsurfaced roads on this unit are the high clay content, the low strength, and the shrink-swell potential of the Ryman soil. Roads and landings can be protected from erosion by constructing water bars and seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Stock water development and fencing will help to improve livestock distribution and the production of vegetation for grazing. More uniform use of range and understory vegetation is aided by properly locating salt and by herding.

Wildlife such as elk, mule deer, bear, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

This map unit is well suited to recreational development on the lower slopes. The main limitations are slopes that are over 8 percent and the slow permeability of the Ryman soil. Paths and trails can be developed.

This map unit is in capability subclass 6c, nonirrigated.

732—Adel-Quazar complex, 5 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes and alluvial fans. The elevation is 9,000 to 11,000 feet. The average annual precipitation is 25 to 35 inches, the annual air temperature is 35 to 38 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 50 percent Adel loam, 40 percent Quazar very cobbly loam, and 10 percent similar soils. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not to affect the use or management of the unit. These include Hourglass loam and Clayburn loam. These similar soils make up about 10 percent of the total acreage; the percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Adel loam

The Adel soil formed in slope alluvium and alluvium derived from mixed sources. Typically, the surface layer is dark grayish brown loam about 14 inches thick. The next layer is dark grayish brown loam about 22 inches thick. The substratum is brown clay loam to a depth of 60 inches or more.

The permeability of the Adel soil is moderate. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Quazar very cobbly loam

The Quazar soil formed in slope alluvium and alluvium derived dominantly from rhyolite and tuff. Typically, the surface layer is dark grayish brown very cobbly loam about 12 inches thick. The subsoil is light brown extremely gravelly clay loam about 14 inches thick. The substratum is brown extremely gravelly clay loam to a depth of 60 inches or more.

The permeability of the Quazar soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. The runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Vegetation

The dominant plant association is *Festuca thurberi/Vicia americana-Lathyrus leucanthus*. The native vegetation on this unit consists mainly of Thurber's fescue, Columbia needlegrass, and mountain brome. Other important plants that characterize this unit are beardless wheatgrass, gooseberry currant, twinberry honeysuckle, Fendler's meadow-rue, Kentucky bluegrass, American vetch, elk sedge, and small pockets of quaking aspen. The average annual production of air-dry vegetation is about 3,000 pounds per acre on the Adel soil and about 2,400 pounds per acre on the Quazar soil.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope and the high content of rock fragments in the Quazar soil.

Wildlife such as elk, mule deer, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock,

prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

This unit is well suited to range production. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of vegetation for grazing. More uniform use of rangeland is aided by properly locating salt and by herding.

If this map unit is used for recreational development, the main limitations are slopes that are over 8 percent in the unit and the content of stones in the Quazar soil. The slopes limit development of most areas of this unit to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Adel soil is in capability subclass 6e, nonirrigated. The Quazar soil is in capability subclass 7s, nonirrigated.

733—Adel-Bucklon complex, 10 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep and shallow, well drained soils on mountain slopes. The elevation is 9,000 to 11,000 feet. The average annual precipitation is 25 to 35 inches, the average annual air temperature is 35 to 38 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 70 percent Adel loam, 20 percent Bucklon loam, and 10 percent included soils. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not to affect the use or management of the unit. These include Hourglass loam and Clayburn loam. These similar soils make up about 8 percent of the total acreage; the percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Adel loam

The Adel soil is very deep. It formed in slope alluvium derived dominantly from mixed sources. Typically, the surface layer is dark grayish brown loam about 14 inches thick. The subsurface layer is dark grayish brown loam about 22 inches thick. The substratum is brown clay loam to a depth of 60 inches or more. The Hourglass and Clayburn soils have clay loam subsoils.

The permeability of the Adel soil is moderate. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Bucklon loam

The Bucklon soil is shallow. It formed in residuum derived dominantly from shale and sandstone. Typically, the surface layer is dark grayish brown loam about 12 inches thick. Shale bedrock is at a depth of 12 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Bucklon soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit is small areas of Wander very cobbly loam on footslopes. Wander soils have more than 35 percent rock fragments in the profile. Included soils make up about 2 percent of the total acreage; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Festuca thurberi/Vicia americana-Lathyrus leucanthus*. The native vegetation on this unit consists mainly of Thurber's fescue, mountain brome, Columbia needlegrass, and beardless wheatgrass. Other important plants that characterize this unit are American vetch, Fendler's meadow-rue, shrubby cinquefoil, Kentucky bluegrass, and western wheatgrass. Quaking aspen occurs in small patches. The average annual production of air-dry vegetation is about 3,000 pounds per acre on the Adel soil, and about 2,100 pounds per acre on the Bucklon soil.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated moderate for this unit because of the slope and underlying shale material in the Bucklon soil.

This unit is well suited to range production. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of vegetation for grazing. More uniform use of rangeland is aided by properly locating salt and by herding.

Wildlife such as elk, mule deer, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the slopes in the unit and the depth to bedrock of the Bucklon soil. The slopes limit development of most areas of this unit to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

734—Ryman-Clayburn complex, 2 to 15 percent slopes**Map Unit Description**

This map unit is a complex of very deep, well drained soils on mesas. The elevation is 8,500 to 10,500 feet. The average annual precipitation is 30 to 35 inches, the average annual air temperature is 35 to 40 degrees F., and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 70 percent Ryman silty clay loam, 20 percent Clayburn loam, and 10 percent included soils. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not to affect the use or management of the unit. These include Adel loam. These similar soils make up about 5 percent of the total acreage; the percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Ryman silty clay loam

The Ryman soil formed in slope alluvium and residuum derived dominantly from shale and sandstone. Typically, the surface layer is grayish brown silty clay loam about 19 inches thick. The upper 17 inches of the substratum are variable yellowish brown and light brownish gray clay. The lower part of the substratum is variable brownish yellow and light brownish gray cobbly clay loam to a depth of 60 inches or more.

The permeability of the Ryman soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Clayburn loam

The Clayburn soil formed in slope alluvium derived from sandstone and shale. Typically, the surface layers are grayish brown and dark grayish brown loam about 13 inches thick. The upper 5 inches of the subsoil are brown light clay loam; the middle part is brown clay loam about 18 inches thick; and the lower 12 inches are light brown sandy clay loam. The substratum is light brown sandy clay loam to a depth of 60 inches or more.

The permeability of the Clayburn soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

There are inclusions of about 3 percent Bucklon loam on ridges and 2 percent Frisco loam on hillslopes. Bucklon soils are shallow. Frisco soils have more than 35 percent rock fragments in the profile.

Vegetation

The dominant plant association on both soils is *Festuca thurberi/Vicia americana-Lathyrus leucanthus*. Also included is *Populus tremuloides/Symphoricarpos oreophilus* in patches of quaking aspen. The native vegetation on this unit consists mainly of Thurber's fescue, Columbia needlegrass, and mountain brome. Other important plants that characterize this unit are American vetch, Nevada pea, cinquefoil, Fendler's meadow-rue, Kentucky bluegrass, Parry's danthonia, western wheatgrass, beardless wheatgrass, and elk sedge. There are also patches of quaking aspen and mountain snowberry, and a few subalpine firs in some of the quaking aspen patches. The average annual production of air-dry vegetation is about 2,800 pounds per acre on both soils.

Soil Management Implications

This unit is used for livestock grazing, timber production, and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

A representative site index for this map unit for quaking aspen is 67 on the Ryman soil. It can produce about 37 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Conventional harvesting methods can be used.

This unit is well suited to the production of quaking aspen. After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants if trees other than aspen are to be grown. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are

Englemann's spruce, white fir, and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest.

The main limitations for building unsurfaced roads on this unit are the high clay content, the shrink-swell potential, and the low strength of the Ryman soil. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of vegetation for grazing. More uniform use of range and understory vegetation is aided by properly locating salt and by herding. This unit is well suited to reseeding. Seeding late in the fall helps to ensure that soil moisture will be adequate for germination in the spring.

Wildlife such as elk, mule deer, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are slopes that are over 8 percent and the slow permeability. Paths and trails can be developed.

This map unit is in capability subclass 6c, nonirrigated.

740—Cowntown-Scout complex, 5 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 9,600 to 11,600 feet. The average annual precipitation is 30 to 40 inches, the average annual air temperature is 32 to 38 F., and the average frost free season is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 50 percent Cowntown loam, 30 percent Scout silt loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Cowntown loam

The Cowntown soil formed in slope alluvium derived dominantly from shale. Typically the surface layer is light brownish gray loam about 3 inches thick. The next layer is light brownish gray silt loam about 2 inches thick. The subsurface layer is light gray cobbly silt loam about 11 inches thick. The upper 17 inches of the subsoil are light gray silty clay; the lower part consists of pale brown silty clay to a depth of 60 inches or more.

The permeability of the Cowntown soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Scout silt loam

The Scout soil formed in slope alluvium derived dominantly from rhyolite. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface

layer is brown silt loam about 1 inch thick. The subsurface layer is light brown very cobbly silt loam about 7 inches thick. The subsoil is brown very cobbly loam about 8 inches thick. The substratum is brownish yellow very cobbly loam to a depth of 61 inches or more.

The permeability of the Scout soil is moderately rapid. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is low, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Frisco loam on the steeper mountain slopes; 5 percent Clayburn loam on toeslopes and structural benches; and 5 percent Seitz loam on mountain slopes. Frisco soils have loamy-skeletal subsoils. Clayburn soils have thick dark colored surface layers. Seitz soils have clayey-skeletal subsoils.

Vegetation

The dominant plant association is *Abies lasiocarpa*-*Picea engelmannii*/*Vaccinium myrtillus*. The native vegetation on this unit consists of Englemann's spruce, subalpine fir, whortleberry, mountain brome, Thurber's fescue, sheep fescue, Richardson's geranium, sedge, and heartleaf arnica. The average annual understory production of air-dry vegetation is about 800 pounds per acre on the Cowtown soil and about 900 pounds per acre on the Scout soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for Englemann's spruce is 80 on the Cowtown soil. It can produce about 76 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Conventional methods of harvesting timber can be used.

This unit is well suited to Englemann's spruce. The main limitation to reforestation is the content of stones. Large stones limit rooting space and soil moisture, and interfere with the planting operations. The high content of rock fragments can make planting of seedling difficult. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitations for building roads on this unit are the content of stones and cobbles in the Scout soil, and the high clay content and shrink-swell potential of the Cowtown soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are slopes that are over 8 percent and the slow permeability of the Cowtown soil. The

slopes limit development of most areas of the unit to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

741—Cowntown-Scout complex, 30 to 60 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes. The elevation is 9,600 to 11,600 feet. The average annual precipitation is 30 to 40 inches, the average annual air temperature is 32 to 38 F., and the average frost free season is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 45 percent Cowntown loam, 35 percent Scout silt loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Cowntown loam

The Cowntown soil formed in slope alluvium derived dominantly from shale. Typically the surface layer is light brownish gray loam about 3 inches thick. The next layer is light brownish gray silt loam about 2 inches thick. The subsurface layer is light gray cobbly silt loam about 11 inches thick. The upper 17 inches of the subsoil are light gray silty clay; the lower part is pale brown silty clay to a depth of 60 inches or more.

The permeability of the Cowntown soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high and the hazard of water erosion is severe. The potential of shrink-swell is high.

Scout silt loam

The Scout soil formed in colluvium and slope alluvium derived dominantly from rhyolite. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is brown silt loam about 1 inch thick. The subsurface layer is light brown very cobbly silt loam about 7 inches thick. The subsoil is brown very cobbly loam about 8 inches thick. The substratum is brownish yellow very cobbly loam to a depth of 61 inches or more.

The permeability of the Scout soil is moderately rapid. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Frisco loam on mountain slopes; 5 percent Clayburn loam on footslopes and structural benches; 3 percent Seitz loam on mountain slopes; and small areas of Rubble land and Cryorthents on the steeper slopes. Frisco soils have loamy-skeletal subsoils. Clayburn soils have thick dark colored surface layers. Seitz soils have clayey-skeletal subsoils. Cryorthents do not have subsoil horizons. Included areas make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists of Englemann's spruce,

subalpine fir, whortleberry, Thurber's fescue, mountain brome, sheep fescue, Richardson's geranium, heartleaf arnica, and sedge. The average annual understory production of air-dry vegetation is about 800 pounds per acre on the Cowtown soil and about 900 pounds per acre on the Scout soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for subalpine fir is 75 on the Cowtown soil. It can produce about 69 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 110 years old.

The mass movement potential is rated moderate for this unit.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed.

The main limitations to reforestation are the content of stones and the slopes. Large stones limit rooting space and soil moisture, and interfere with the planting operations. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitations for building unsurfaced roads on this unit are the content of stones and cobbles in the Scout soil, the high clay content and the shrink-swell potential of the Cowtown soil, and the slopes of both soils. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitation is the presence of steep slopes. These slopes limit the areas to a few paths and trails that should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

750—Archuleta-Sheek complex, 12 to 65 percent slopes

Map Unit Description

This map unit is a complex of shallow and very deep, well drained soils on mountain slopes and canyon side slopes. The surface is covered with 1 to 3 percent stones. The elevation is 7,500 to 8,500 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is 40 to 45 degrees F., and the average frost-free period is 90 to 110 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 50 percent Archuleta stony clay loam, 35 percent Sheek very stony sandy loam, and 15 percent included soils. The components of this unit

are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Archuleta stony clay loam

The Archuleta soil is shallow. It formed in residuum and slope alluvium derived dominantly from shale and sandstone. Typically, the surface layer is light brownish gray stony clay loam about 3 inches thick. The underlying material is brown clay loam to a depth of 16 inches. Shale bedrock is at a depth of 16 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Archuleta soil is moderately slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Sheek very stony sandy loam

The Sheek soil is very deep. It formed in colluvium and slope alluvium derived dominantly from sandstone and shale. Typically, the surface is covered with a mat of leaves, twigs, and needles about 1 inch thick. The surface layer is grayish brown very stony sandy loam about 5 inches thick. The subsurface layer is light brownish gray very stony sandy loam about 2 inches thick. The upper part of the subsoil is brown very stony sandy clay loam about 16 inches thick, and the lower part is brown very stony clay loam about 19 inches thick. The substratum is light brown very stony sandy clay loam to a depth of 61 inches or more.

The permeability of the Sheek soil is moderately slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Goldbug very stony fine sandy loam on mountain slopes; 5 percent Fughes loam on hills; small areas of Hesperus loam in drainageways; small areas of Herm loam on hills; and small areas of Rock outcrop. Goldbug soils have less than 35 percent rock fragments in the subsoil. Fughes, Herm, and Hesperus soils have dark colored surface layers and less than 35 percent rock fragments in the subsoil. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation on this unit consists mainly of ponderosa pine, Gambel oak, bluegrass, and Arizona fescue. Other important plants that characterize this unit are mountain brome, western wheatgrass, mountain muhly, prairie Junegrass, antelope bitterbrush, Saskatoon serviceberry, common snowberry, true mountain mahogany, and Rocky Mountain Douglas-fir. The average annual understory production of air-dry vegetation is about 500 pounds per acre on the Archuleta soil and about 550 pounds per acre on the Sheek soil.

Soil Management Implications

This unit is used for wildlife habitat, timber production, and limited livestock grazing.

A representative site index for this map unit for ponderosa pine is 45 on the Archuleta soil. It can produce about 34 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 60 years old.

The mass movement potential is rated low for the Archuleta soil and moderate for the Sheek soil.

The main concerns in producing and harvesting timber are reforestation, road construction in the shallow soils and controlling erosion along roads and other places where vegetation has been removed. Conventional harvesting methods generally are restricted to slopes of less than 40 percent. Access to the steeper areas is limited. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. The steep slopes limit the kinds of equipment that can be used in forest management.

The main limitations to reforestation on this unit are the steep slopes and shallow soils on the Archuleta soil, and the content of stones on the unit. Brushy plants such as Gambel oak limit natural regeneration of ponderosa pine. The high content of rock fragments can make the planting of seedlings difficult. Among the trees that are suitable for planting is ponderosa pine. Grazing in harvested areas should be deferred for at least 2 years to assure development of sufficient plant cover to protect the soil from erosion.

Careful consideration of road systems and harvesting methods should be made to minimize erosion. The main limitations to the building of unsurfaced roads on this unit are the steep slopes on the unit and the depth to bedrock of the Archuleta soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. If the condition of the range and understory vegetation deteriorates, Gambel oak increases. Areas where brush is managed by prescribed burning, chemical or mechanical methods may be subject to a greater hazard of erosion. The slope limits access by livestock and results in overgrazing of the less sloping areas. Mechanical treatment practices are not practical, because the surface is stony and the slopes are steep.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes, the content of stones, and the depth to bedrock in the Archuleta soil. The slopes limit the use of the unit mainly to a few paths and trails, which should extend across the slopes. Drainage should be provided for cuts and fills. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

801—Fughes-Sheek complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on hills and mountain slopes. The surface of this map unit is covered with about 3 to 15 percent stones. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is 40 to 45 degrees F., and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 50 percent Fughes loam, 35 percent Sheek very cobbly clay loam, and 15 percent included soils. The components of this unit are so

intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Fughes loam

The Fughes soil formed in slope alluvium and colluvium derived dominantly from sandstone and shale. Typically, the surface layer is dark brown loam about 7 inches thick. The upper 19 inches of the subsoil are brown clay loam, and the lower 18 inches are brown clay. The substratum is strong brown clay to a depth of 60 inches or more.

The permeability of the Fughes soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is high.

Sheek very cobbly clay loam

The Sheek soil formed in slope alluvium and colluvium derived from sandstone and shale. Typically, the surface layer is dark brown very cobbly clay loam about 2 inches thick. The upper 5 inches of the subsoil are dark yellowish brown gravelly clay loam; the next 13 inches of the subsoil are brown very cobbly clay loam; the next 9 inches of the subsoil are very pale brown very cobbly loam; and the next 17 inches are light gray cobbly clay loam. The substratum is white very cobbly loam to a depth of 60 inches or more.

The permeability of the Sheek soil is moderately slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 8 percent Ormiston very stony loam on hillslopes; 5 percent Nortez loam on mesas; small areas of Rock outcrop; and small areas that have carbonates in the lower part of the profile. Ormiston soils have sandstone bedrock at depths of 40 to 60 inches. Nortez soils are moderately deep over sandstone. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation consists of ponderosa pine, Gambel oak, western wheatgrass, prairie Junegrass, mountain brome, and Utah serviceberry. Other plants that characterize this unit are mountain muhly, muttongrass, bluegrass, Letterman's needlegrass, bottlebrush squirreltail, Indian ricegrass, Woods' rose, and common snowberry. The average annual understory production of air-dry vegetation is about 1,300 pounds per acre on the Fughes soil and about 950 pounds per acre on the Sheek soil.

Soil Management Implications

This unit is used for livestock grazing, timber production, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 80 for the Fughes soil. It can produce about 69 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 40 years old.

The mass movement potential is rated moderate for this unit.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Timber productivity is estimated to be moderate. Conventional methods of harvesting timber can be used. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. Brushy plants such as Gambel oak limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Trees that are suitable for planting are ponderosa pine. Other trees suited to this unit are white fir and lodgepole pine.

The main limitations to the building of unsurfaced roads on this unit are the stoniness, low strength, and slopes on the unit; and the high clay content and shrink-swell potential of the Fughes soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of understory vegetation. If the condition of the range or understory deteriorates, Gambel oak increases. Areas where brush is managed by prescribed burning, chemical or mechanical methods may be subject to a greater hazard of erosion. The main limitations for seeding are the content of stones on the surface and the slopes. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the large stones and the slope. The slope limits use of the unit mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Fughes soil is in capability subclass 6e, nonirrigated. The Sheek soil is in capability subclass 7s, nonirrigated.

802—Argiustolls-Haplustalfs-Rock outcrop complex, 30 to 80 percent slopes

Map Unit Description

This map unit is a complex of shallow to very deep, well drained soils and Rock outcrop on steep to very steep canyon side slopes and mountain slopes. The surface of this unit is covered with 3 to 15 percent stones. The elevation is 6,900 to 8,500 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 42 to 46 degrees F, and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This unit consists of 30 percent Argiustolls, 30 percent Haplustalfs, 25 percent Rock outcrop, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Argiustolls

The Argiustolls soil is moderately deep to very deep. It formed in slope alluvium and colluvium derived mostly from sandstone and shale. In a reference pedon, the surface is covered with a layer of organic material about 1 inch thick. The surface

layer is very dark grayish brown extremely stony loam about 3 inches thick. The upper part of the subsoil is grayish brown and brown extremely stony clay loam about 9 inches thick; the next part is yellowish brown very stony clay loam about 7 inches thick; and the lower part of the subsoil is yellowish brown cobbly clay loam about 17 inches thick. The upper 13 inches of the substratum are light gray cobbly clay, and the lower part is light brownish gray clay to a depth of 61 inches or more.

The permeability of the Argiustolls soil is slow. The available water capacity is very low to moderate. The hydrologic group is B. The effective rooting depth is 20 to 60 inches or more. The depth to bedrock is 20 to 60 inches or more from the mineral soil surface. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Haplustalfs

The Haplustalfs soil is shallow to very deep. It formed in slope alluvium and colluvium derived mostly from sandstone and shale. In a reference pedon, the surface layer is brown very stony loam about 5 inches thick. The subsurface layer is very pale brown very stony clay loam about 5 inches thick. The upper part of the subsoil is pale brown very stony clay about 14 inches thick. The lower part of the subsoil is light yellowish brown very stony clay about 17 inches thick. The substratum is light yellowish brown very stony clay and extremely stony clay to a depth of 60 inches or more.

The permeability of the Haplustalfs soil is slow. The available water capacity is very low to high. The hydrologic group is C. The effective rooting depth is 10 to 60 inches or more. The depth to bedrock is 10 to 60 inches or more from the mineral soil surface. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Rock outcrop

Rock outcrop consists of exposures of sandstone and shale as ledges, and on the steep side slopes.

Contrasting Inclusions

Included in this unit are areas with fine-loamy soils on canyon side slopes and mountain slopes, and areas with more than 15 percent surface stones and boulders. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation consists mainly of ponderosa pine, Rocky Mountain Douglas-fir, Rocky Mountain Juniper, Gambel oak, muttongrass, Utah snowberry, Utah serviceberry, true mountain mahogany, elk sedge, prairie Junegrass, bottlebrush squirreltail, and antelope bitterbrush. The average annual understory production of air-dry vegetation is about 800 pounds per acre on the Argiustolls soil and about 700 pounds per acre on the Haplustalfs soil.

Soil Management Implications

This map unit is used for wildlife habitat, limited livestock grazing, and limited timber production.

A representative site index for this map unit for ponderosa pine is 80 on the Argiustolls soil. It can produce about 69 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 40 years old.

The mass movement potential is rated high for this unit because of steep slopes, low strength, and rock fall potential.

Timber productivity is estimated to be low. The main concerns in producing and harvesting timber are slope, large stones, and depth to bedrock. Only the less sloping areas should be considered for harvesting timber. Conventional harvesting methods

generally are restricted to slopes of less than 40 percent. Access to the steeper areas is limited. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment.

Large stones limit rooting space and soil moisture, and interfere with planting operations.

The main limitations to the building of unsurfaced roads on this unit are the steep slopes, the content of large stones, rock outcrops, and the depth to bedrock.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. The slope limits access by livestock and results in overgrazing of the less sloping areas.

Wildlife such as elk, mule deer, bear, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

This map unit is poorly suited to recreational development. The main limitations are the content of large stones, steep slopes, the depth to bedrock, rock outcrops, and the hazard of erosion. Recreational development is limited mainly to a few paths and trails that should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Argiustolls and Haplustalfs soils are in capability subclass 7e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

804—Wauquie-Dolcan-Rock outcrop complex, 25 to 80 percent slopes

Map Unit Description

This map unit is a complex of very shallow to very deep, well drained soils and Rock outcrop on steep to very steep canyon side slopes and hills. The dominant aspect is south, east and west. The surface is covered with 3 to 15 percent stones. The elevation is 6,000 to 8,200 feet. The average annual precipitation is 13 to 16 inches, the average annual air temperature is 47 to 50 degrees F, and the average frost-free period is 100 to 135 days. The moisture regime is aridic-ustic and the temperature regime is mesic.

This unit consists of 40 percent Wauquie very cobbly loam, 25 percent Dolcan cobbly clay loam, 20 percent Rock outcrop, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Wauquie very cobbly loam

The Wauquie soil is very deep. It formed in colluvium and slope alluvium derived from sandstone and shale. The surface layer is brown very cobbly loam 3 inches thick. The upper 6 inches of the subsoil are yellowish brown very cobbly loam, and the lower 5 inches are yellowish brown very cobbly clay loam. The substratum is pinkish white gravelly clay loam to a depth of 60 inches or more.

The permeability of the Wauquie soil is moderate. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Dolcan cobbly clay loam

The Dolcan soil is shallow or very shallow. It formed in colluvium and residuum derived from sandstone and shale. Typically, the surface layer is light brownish gray cobbly clay loam about 4 inches thick. The next layer is brown gravelly clay loam about 5 inches thick. The next layer is pale brown gravelly clay loam about 7 inches thick. Weathered shale is at a depth of 16 inches; however, the depth to bedrock generally ranges from 6 to 20 inches.

The permeability of the Dolcan soil is moderately slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 6 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of sandstone as cliffs and escarpments.

Contrasting Inclusions

Included in this unit are about 5 percent moderately deep soils on ridges; 8 percent shallow soils over hard bedrock near the Rock outcrop; and small areas of Wetherill loam on benches. Wetherill soils are very deep and lack rock fragments. Included soils make up about 15 percent of the total acreage; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus edulis/Quercus gambelii*. The native vegetation consists mainly of twoneedle pinyon, Utah juniper, Gambel oak, and western wheatgrass. Other plants that characterize this unit are Indian ricegrass, galleta, pinyon ricegrass, muttongrass, true mountain mahogany, big sagebrush, common snowberry, antelope bitterbrush, and Utah serviceberry. The average annual understory production of air-dry vegetation is about 900 pounds per acre on the Wauquie soil and about 500 pounds per acre on the Dolcan soil.

Soil Management Implications

This map unit is used for wildlife habitat and limited livestock grazing.

The mass movement potential is rated high for this unit because of steep slopes and rock fall potential (*Fig. 18*).

Some fire wood and fence posts may be harvested from some locations. Productivity is estimated to be low. The main concerns in producing and harvesting timber are steep slopes, depth to rock, stones on the surface, and Rock outcrop.

The main limitations to the building of unsurfaced roads on this unit are the slope, the content of large stones, and the depth to bedrock.

The main limitations to livestock grazing on this unit are the content of large stones, the slope, and limited precipitation to produce adequate vegetation. Large stones limit rooting space and water-holding capacity of the soil. This unit is generally not suited to reseeding because of the stones, slope, and low precipitation. Steep slopes result in excessive use of lower slopes.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

This map unit is poorly suited to recreational development. The main limitations are the content of large stones, the depth to bedrock, steep slopes, and rock outcrops. The slopes limit use of the unit to a few paths and trails that should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

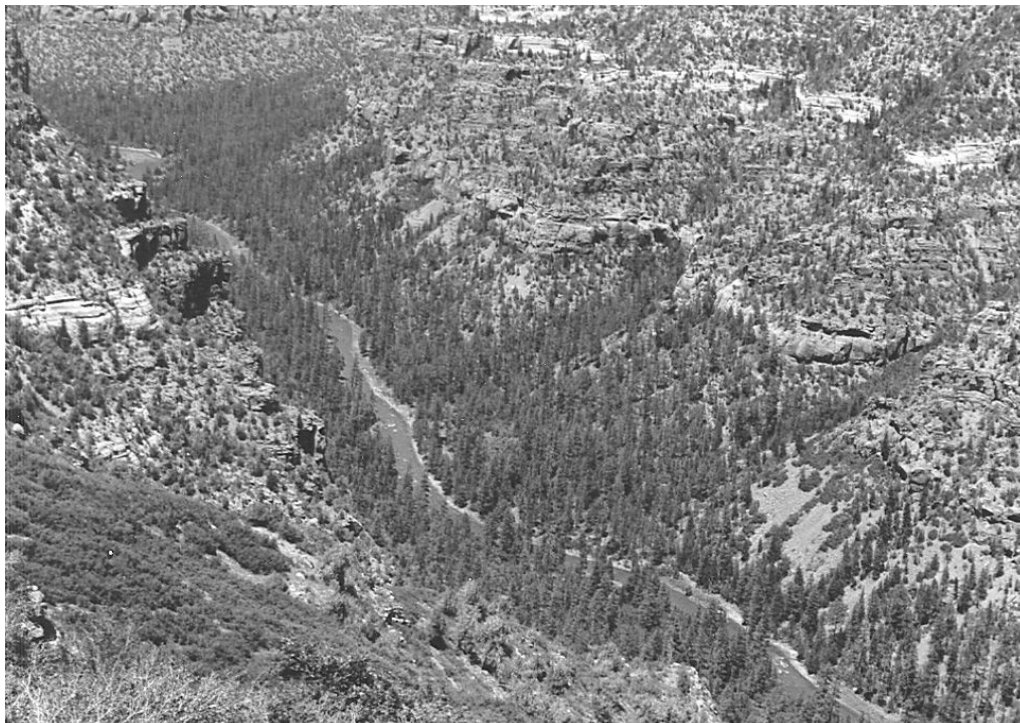


Figure 18.—Shown is a landscape of Wauquie-Dolcan-Rock outcrop complex, 25 to 80 percent slopes. This is along the Dolores River canyon.

The Wauquie and Dolcan soils are in capability subclass 7e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

805—Shawa-Fughes complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on hills and footslopes of hills. The elevation is 7,500 to 8,500 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is 40 to 45 degrees F., and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 50 percent Shawa loam, 40 percent Fughes loam, and 10 percent included soils. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not to affect the use or management of the unit. These include Ohwiler loam. Similar inclusions make up about 3 percent of the map unit. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Shawa loam

The Shawa soil formed in slope alluvium derived dominantly from shale and sandstone. Typically, the surface layer is brown loam about 19 inches thick. The upper 19 inches of the underlying material are brown clay loam, and the lower part is brown cobbly clay loam to a depth of 60 inches or more.

The permeability of the Shawa soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more.

Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Fughes loam

The Fughes soil formed in slope alluvium derived dominantly from shale and sandstone. Typically, the surface is covered with a mat of slightly decomposed needles and twigs about 1 inch thick. The surface layer is dark brown loam about 7 inches thick. The upper 19 inches of the subsoil are brown clay loam, and the lower 18 inches are brown clay. The substratum is strong brown clay to a depth of 61 inches or more.

The permeability of the Fughes soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 4 percent soils with more than 35 percent rock fragments on hillslopes, and small areas of shallow and moderately deep soils near occasional sandstone Rock outcrop on hillslopes. These inclusions make up about 7 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus*. The native vegetation on this unit consists mainly of quaking aspen, common snowberry, mountain brome, Arizona fescue, and a few ponderosa pines. Other important plants that characterize this unit are western wheatgrass, needlegrass, muttongrass, Gambel oak, bluegrass, Parry's danthonia, mountain muhly, and Utah serviceberry. The average annual understory production of air-dry vegetation is about 2,500 pounds per acre on the Shawa soil and about 2,000 pounds per acre on the Fughes soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for quaking aspen is 60 on the Shawa soil. It can produce about 32 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 80 years old.

The mass movement potential is rated moderate for this unit.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Conventional methods of harvesting timber can be used.

This unit is moderately suited to the production of quaking aspen. The main limitation to reforestation on these soils is the plant competition if trees other than quaking aspen are to be grown. Competing vegetation can be controlled by properly preparing the site and by spraying or cutting unwanted weeds, brush, or trees. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting is ponderosa pine. Quaking aspen will usually regenerate from roots after harvest.

The main limitations to the building of unsurfaced roads on this unit are the slopes on the unit and the low strength of the Fughes soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Stock water development and

fencing will help to improve livestock distribution and the production of understory vegetation.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitation is the slope, which limits the use of the unit mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

806—Shawa-Fughes complex, 30 to 60 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on hills. The surface of this map unit is covered with about 1 to 3 percent stones. The elevation is 7,500 to 8,500 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is 40 to 45 degrees F., and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 45 percent Shawa loam, 35 percent Fughes loam, and 20 percent included soils. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not to affect the use or management of the unit. These include Ohwiler loam. Similar inclusions make up about 5 percent of the map unit; the percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Shawa loam

The Shawa soil formed in slope alluvium and colluvium derived dominantly from shale and sandstone. Typically, the surface layer is brown loam about 19 inches thick. The upper 19 inches of the underlying material are brown clay loam, and the lower part is brown cobbly clay loam to a depth of 60 inches or more.

The permeability of the Shawa soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The surface is very stony. The potential of shrink-swell is low.

Fughes loam

The Fughes soil formed in slope alluvium and colluvium derived dominantly from shale and sandstone. Typically, the surface is covered with a mat of slightly decomposed needles and twigs about 1 inch thick. The surface layer is dark brown loam about 7 inches thick. The upper 19 inches of the subsoil are brown clay loam, and the lower 18 inches are brown clay. The substratum is strong brown clay to a depth of 61 inches or more.

The permeability of the Fughes soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high and the hazard of water erosion is severe. The surface is very stony. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 10 percent soils with more than 35 percent rock fragments on hillslopes; small areas of shallow and moderately deep soils near sandstone Rock outcrop on hillslopes; and small areas of Rock outcrop. These

inclusions make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus*. The native vegetation on this unit consists mainly of quaking aspen, common snowberry, mountain brome, Arizona fescue, and a few ponderosa pines. Other important plants that characterize this unit are Gambel oak, western wheatgrass, needlegrass, muttongrass, bluegrass, Parry's danthonia, mountain muhly, and Utah serviceberry. The average annual understory production of air-dry vegetation is about 2,500 pounds per acre on the Shawa soil and about 2,000 pounds per acre on the Fughes soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for quaking aspen is 60 on the Shawa soil. It can produce about 32 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 80 years old.

The mass movement potential is rated high for this unit because of steep slopes and low strength.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Conventional methods of harvesting timber can be used.

This unit is moderately suited to the production of quaking aspen. The main limitations to reforestation on these soils are the plant competition if trees other than aspen are to be grown, and the steep slopes. Competing vegetation can be controlled by properly preparing the site and by spraying or cutting to eliminate unwanted weeds, brush, or trees. Brushy plants such as Gambel oak and snowberry limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are ponderosa pine, white fir, and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest.

The main limitations to the building of unsurfaced roads on this unit are the steep slopes on the unit and the low strength of the Fughes soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Stock water development and fencing will help to improve livestock distribution and the production of understory vegetation. The slope limits access by livestock and results in overgrazing of the less sloping areas. Mechanical treatment practices are not practical, because the surface is stony and the slopes are steep.

Wildlife such as elk, mule deer, bear, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes and the hazard of erosion. The slopes limit the use of the unit mainly to a few paths and trails, which should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

809—Argiustolls-Haplustalfs complex, 30 to 80 percent slopes

Map Unit Description

This map unit is a complex of shallow to very deep, well drained soils on canyon side slopes and mountain slopes. The surface of this map unit is covered with about 1 to 3 percent stones. The elevation is 6,900 to 8,500 feet. The average annual precipitation is 15 to 22 inches, the average annual air temperature is 40 to 44 degrees F., and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This unit consists of 45 percent Argiustolls, 40 percent Haplustalfs, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Argiustolls

Argiustolls are moderately deep to very deep. They formed in colluvium and slope alluvium derived from sandstone and shale. In a reference pedon, the surface is covered with slightly decomposed needles and leaves about 1 inch thick. The surface layer is very dark grayish brown extremely stony loam about 3 inches thick. The upper part of the subsoil is grayish brown and brown extremely stony clay loam about 9 inches thick. The next part is yellowish brown very stony clay loam about 7 inches thick. The lower part of the subsoil is yellowish brown cobbly clay loam about 17 inches thick. The upper 13 inches of the substratum are light gray cobbly clay, and the lower part consists of light brownish gray clay to a depth of 61 inches or more.

The permeability of the Argiustolls soil is slow. The available water capacity is very low to moderate. The hydrologic group is B. The effective rooting depth is 20 to 60 inches or more. The depth to bedrock is 20 to 60 inches or more from the mineral soil surface. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low moderate.

Haplustalfs

The Haplustalfs soil is shallow to very deep. It formed in slope alluvium and colluvium derived mostly from sandstone and shale. In a reference pedon, the surface layer is brown very stony loam about 5 inches thick. The subsurface layer is very pale brown very stony clay loam about 5 inches thick. The upper part of the subsoil is pale brown very stony clay about 14 inches thick. The lower part of the subsoil is light yellowish brown very stony clay about 17 inches thick. The substratum is light yellowish brown very stony clay and extremely stony clay to a depth of 60 inches or more.

The permeability of the Haplustalfs soil is slow. The available water capacity is very low to high. The hydrologic group is C. The effective rooting depth is 10 to 60 inches or more. The depth to bedrock is 10 to 60 inches or more from the mineral soil surface. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 5 percent Rock outcrop on ridges and breaks; 5 percent shallow soils that lack argillic horizons on mountain slopes; and 5 percent of soils that have more stones and boulders on the surface. These inclusions make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pseudotsuga menziesii*/*Amelanchier alnifolia*. The native vegetation on this unit is Rocky Mountain Douglas-fir, Utah serviceberry,

Gambel oak, Englemann's spruce, subalpine fir, and quaking aspen. Other common understory plants include Utah snowberry, true mountain mahogany, antelope bitterbrush, prairie Junegrass, bottlebrush squirreltail, muttongrass, and elk sedge. The average annual understory production of air-dry vegetation is about 1,000 pounds per acre on the Argiustolls soil and about 900 pounds per acre on the Haplustalfs soil.

Soil Management Implications

This unit is used for wildlife habitat, woodland, and limited livestock grazing.

A representative site index for this map unit for Rocky Mountain Douglas-fir is 75 on the Haplustalfs soil. It can produce about 62 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated high for this unit because of steep slopes.

Timber productivity is estimated to be low. The main concerns in producing and harvesting timber are steep slopes, stones, and rock outcrops. Only the least sloping areas should be considered for any timber harvesting. Conventional harvesting methods generally are restricted to slopes of less than 40 percent. Access to the steeper areas is limited. Stones on the surface can interfere with felling, yarding, and other operations involving the use of equipment. The steep slopes limit the kinds of equipment that can be used in forest management.

The main limitations to reforestation on this unit are the steep slope, the content of large stones, and shallow soils. Large stones limit rooting space and soil moisture, and interfere with planting operations.

The main limitations to the building of unsurfaced roads on this unit are the steep slopes, shallow soils, content of large stones, and rock outcrops. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. The slope limits access by livestock and results in overgrazing of the less sloping areas. Mechanical treatment practices are not practical because the surface is stony and the slopes are steep.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the content of large stones, steep slopes, the depth to bedrock, and the hazard of erosion. The slopes limit use of the unit to a few paths and trails that should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

813—Fughes silty clay loam, 5 to 30 percent slopes

Map Unit Description

This very deep, well drained soil is on mesas and hills. The elevation is 7,100 to 8,000 feet. The average annual precipitation is 16 to 18 inches and the mean annual air temperature is 42 to 46 degrees F. The frost-free period is 75 to 100 days. The soil moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Fughes silty clay loam

The Fughes soil formed in slope alluvium derived dominantly from shale. Typically, the surface layer is dark brown silty clay loam about 7 inches thick. The upper 19 inches of the subsoil are brown clay loam, and the lower 18 inches are brown clay. The substratum is strong brown clay to a depth of 60 inches or more.

The permeability of the Fughes soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this map unit are about 5 percent Granath loam on hillslopes; 5 percent Hesperus loam in drainageways; small areas of soils that are moderately deep over shale bedrock on the steeper part of hillslopes; small areas with very stony surface layers and fine-loamy subsoils on hillslopes; and small areas of Nortez loam on hillslopes. Granath soils have dark surface layers less than 16 inches thick. Hesperus soils have fine-loamy subsoils. Nortez soils are moderately deep over hard sandstone. Included areas make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation consists of scattered ponderosa pine, Gambel oak, basin big sagebrush, Arizona fescue, mountain muhly, western wheatgrass, prairie Junegrass, mountain brome, bluegrass, and needleandthread. The average annual understory production of air-dry vegetation is about 1,300 pounds per acre.

Soil Management Implications

This unit is used primarily for livestock grazing and wildlife habitat. The unit is also used to a limited extent for timber production.

A representative site index for this map unit for ponderosa pine is 90 on the Fughes soil. It can produce about 85 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 40 years old.

The mass movement potential is rated low for this unit because of the slope.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Conventional harvesting methods can be used. The soils generally are stable, but stability is a limitation when they are wet.

The main limitations to reforestation on this unit are the plant competition and limited rainfall. After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. Brushy plants such as Gambel oak limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting is ponderosa pine.

The main limitations to the building of unsurfaced roads on this unit are the low strength, high clay content, and high shrink-swell potential. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of understory

vegetation. Areas where brush is managed by prescribed burning, chemical or mechanical methods may be subject to a greater hazard of erosion. If the range or understory vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the slopes that are over 8 percent and the slow permeability. The slopes limit most of the unit to paths and trails. Paths and trails should be provided with drainage. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

814—Leaps-Hofly complex, 5 to 40 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes and mesas. The elevation is 8,500 to 9,200 feet. The average annual precipitation is 20 to 26 inches, and the average annual air temperature is 35 to 40 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are ustic and cryic, respectively.

This map unit consists of 50 percent Leaps clay loam, 35 percent Hofly loam, and 15 percent included soils. The components are so intricately intermingled that it was not practical to separate them at the scale used.

Brief Soil Description

Leaps clay loam

The Leaps soil formed in slope alluvium derived dominantly from shale and sandstone. Typically the surface layer is grayish brown and gray clay loam about 14 inches thick. The subsoil is light brownish gray clay loam about 8 inches thick. The substratum is light brownish gray clay to a depth of 60 inches or more.

The permeability of the Leaps soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is high.

Hofly loam

The Hofly soil formed in slope alluvium derived dominantly from shale and sandstone. Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is grayish brown clay loam about 23 inches thick. The substratum is pale brown clay to a depth of 60 inches or more.

The permeability of the Hofly soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 10 percent Teedown loam on structural benches; small areas of Wander very cobbly loam on toeslopes; and small areas of Clayburn loam on toeslopes and in drainageways. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Quercus gambelii*/*Symphoricarpos oreophilus* on the Hofly soil and *Artemisia tridentata*/*Elytrigia smithii* on the Leaps soil. The native vegetation on this unit consists mainly of Gambel oak, mountain snowberry, mountain big sagebrush, western wheatgrass, Arizona fescue, and elk sedge. Other important plants that characterize this unit are needlegrass, bluegrass, slender wheatgrass, mountain brome, prairie Junegrass, muttongrass, mule-ears, and Saskatoon serviceberry. The average annual production of air-dry vegetation is about 2,000 pounds per acre on both soils.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the high clay content and low strength of both soils, and the shrink-swell potential of the Leaps soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

This unit is well suited to livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and range condition. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning, chemical, or mechanical methods may be subject to a greater hazard of erosion. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the slopes that are over 8 percent and the slow permeability. Development is limited mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

815—Behanco-Powderhorn family complex, 0 to 15 percent slopes

Map Unit Description

This map unit is a complex of deep and very deep, well drained soils on mesas. The elevation is 8,500 to 10,000 feet. The average annual precipitation is 25 to 30 inches, the average annual air temperature is 34 to 40 degrees F., and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 45 percent Behanco loam, 40 percent Powderhorn family loam, and 15 percent included soils. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not to affect the use or management of the unit. These include Sudduth loam. These similar soils make up about 5 percent of the total acreage; the percentage

varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Behanco loam

The Behanco soil is deep. It formed in residuum and slope alluvium derived dominantly from sandstone. Typically, the upper part of the surface layer is grayish brown loam about 2 inches thick. The lower part of the surface layer is brown very flaggy loam about 15 inches thick. The subsurface layer is very pale brown very channery loam about 8 inches thick. The subsoil is very pale brown very channery loam about 8 inches thick. The upper 12 inches of the substratum are yellow very channery sand, and the next 2 inches are yellow clay. The next layer is yellow, weathered sandstone at a depth of 59 inches.

The permeability of the Behanco soil is moderate through the subsoil. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 40 to 60 inches. Runoff is medium and the hazard of water erosion is slight. The potential of shrink-swell is low.

Powderhorn family loam

The Powderhorn family soil is deep to very deep, and well drained. It formed in slope alluvium derived dominantly from sandstone. Typically, the surface is covered with a mat of intermediately decomposed leaves, needles, and twigs 1 inch thick. The surface layer is brown loam 11 inches thick, and the next layer is yellowish brown and brown loam 12 inches thick. The upper 8 inches of the subsoil are very pale brown cobbly clay the lower 9 inches are light gray clay. The substratum is gray clay to a depth of 60 inches. Hard Dakota sandstone is at a depth of 60 inches.

The permeability of the Powderhorn soil is slow. The available water capacity is high. The hydrologic group is C. The depth to bedrock ranges from 40 to 60 inches or more from the mineral soil surface. The effective rooting depth is 40 inches or more. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is high in the lower part of the subsoil and in the substratum.

Contrasting Inclusions

Included in this unit are about 5 percent Storm extremely flaggy loam on ridges; small areas of moderately deep soils on mesas; and small areas of shallow soils on ridges and mesa edges. Storm soils have light colored surface layers and loamy-skeletal subsoils. Included areas make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus*. Some *Abies lasiocarpa-Picea engelmannii/Carex geyeri* also occurs. The native vegetation consists mainly of quaking aspen, Englemann's spruce, subalpine fir, white fir, and common snowberry. Other plants that characterize this unit includes Columbia needlegrass, nodding brome, bluegrass, Parry's danthonia, beardless wheatgrass, slender wheatgrass, elk sedge, California false hellebore, Richardson's geranium, Nevada pea, American vetch, heartleaf arnica, and Fendler's meadow-rue. The average annual understory production of air-dry vegetation is about 3,000 pounds per acre on both soils.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for quaking aspen is 69 on the Behanco soil. It can produce about 38 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope.

This unit is well suited to the production of quaking aspen. Timber productivity is estimated to be moderately high. The main concern in producing and harvesting timber is reforestation. Conventional methods of harvesting timber generally can be used, but their use may be limited when the soil is wet. Stones in the soil can interfere with road construction and tree planting. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, and high rainfall.

After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. If the site is not adequately prepared, competition from undesirable plants can prevent or prolong natural or artificial reestablishment of trees if trees other than quaking aspen are to be grown. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest. Grazing in harvested areas should be deferred for at least 2 years to assure development of sufficient plant cover to protect the soil from erosion.

The main limitations to the building of unsurfaced roads on this unit are the high clay content in the lower part of the Powderhorn soil and the content of large stones and cobbles in the unit. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants. More uniform use of range and understory vegetation is aided by properly locating salt and by herding.

Wildlife such as elk, mule deer, bear, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the slopes that are over 8 percent on the unit and the slow permeability of the Powderhorn soil. Campgrounds and picnic areas can be developed on the lower slopes. Paths and trails can be developed.

This map unit is in capability subclass 6c, nonirrigated.

816—Storm extremely flaggy loam, 15 to 30 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 10,000 to 11,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Storm extremely flaggy loam

The Storm soil formed in residuum derived dominantly from sandstone. Typically, the surface is covered with a mat of slightly to highly decomposed needles, twigs, and roots 2 inches thick. The surface layer is dark brown extremely flaggy loam 4 inches thick. The subsurface layer is pale brown extremely flaggy loam 7 inches thick. The upper part of the subsoil is pale brown extremely flaggy clay loam about 6 inches thick. The next part is light yellowish brown very gravelly clay loam about 12 inches

thick. The lower part of the subsoil is very pale brown extremely cobbly clay loam about 9 inches thick. The upper 8 inches of the substratum are brownish yellow very gravelly loam; the next 8 inches are very pale brown extremely gravelly loam; and the lower part consists of light yellowish brown extremely gravelly clay loam to a depth of 62 inches or more.

The permeability of the Storm soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 8 percent soils with thick dark colored surface layers on the less sloping areas, small areas of soils that have fine textured subsoils, and small areas that have clayey-skeletal subsoils, all on hillslopes; and small areas that are shallow or moderately deep over bedrock on ridges and breaks to drainageways. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Picea engelmannii* / *Vaccinium scoparium*. *Abies lasiocarpa*-*Picea engelmannii*/*Vaccinium scoparium* occurs in some places. The native vegetation consists of Englemann's spruce, subalpine fir, quaking aspen, grouse whortleberry, Richardson's geranium, Fendler's meadow-rue, American vetch, elderberry, mountain snowberry, sedge, slender wheatgrass, Columbia needlegrass, bluegrass, and nodding brome. The average annual understory production of air-dry vegetation is about 800 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for Englemann's spruce is 84 on the Storm soil. It can produce about 82 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old. The average canopy cover ranges from 70 to 85 percent for the overstory.

The mass movement potential is rated low for this unit because of the slope because of the high content of rock fragments.

The Storm soil is well suited to the production of Englemann's spruce. Timber productivity is estimated to be high. The main concerns in producing and harvesting timber are reforestation and large stones in the soil that interfere with road construction and tree planting. Conventional methods of harvesting timber can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt and high rainfall. Harvesting some of the mature trees for lumber and thinning dense stands of younger trees for use as poles increases the growth rate of the rest of the stand and increases the understory vegetation.

The main limitations to reforestation on this soil are the content of stones in the surface layer. Large stones limit rooting space and soil moisture, and interfere with planting operations. The high content of rock fragments can make the planting of seedlings difficult. After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitations to the building of unsurfaced roads on this unit are the content of stones in the soil and the slopes. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the content of large stones and the slopes. The slopes limit use of the unit mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7s, nonirrigated.

826—Ute-Frisco complex, 0 to 20 percent slopes

Map Unit Description

This map unit is a complex of very deep well drained and poorly drained soils on mesas, in drainageways and in depressions on mesas. The elevation is 10,000 to 11,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are aquic and cryic for the Ute soil, respectively, and udic and cryic for the Frisco soil, respectively.

This map unit consists of 50 percent Ute loam, 40 percent Frisco cobbly loam, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Descriptions

Ute loam

The Ute soil is poorly drained. It formed in alluvium derived dominantly from shale and sandstone. Typically, the surface is covered with a mat of slightly decomposed organic material about 2 inches thick. The surface layer is very dark grayish brown loam about 5 inches thick. The upper part of the subsoil is very dark gray clay loam with yellowish brown redox concentrations about 6 inches thick. The lower part of the subsoil consists of gray clay and clay loam with yellowish brown redox concentrations about 32 inches thick. The substratum is gray clay loam with yellowish brown redox concentrations to a depth of 62 inches or more.

The permeability of the Ute soil is slow. The available water capacity is high. The hydrologic group is D. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 6 to 18 inches from January through December. The potential of shrink-swell is high.

Frisco loam

The Frisco soil is well drained. It formed in slope alluvium derived dominantly from volcanic and sedimentary rocks. Typically, the surface is covered with a mat of twigs, needles, and bark about 2 inches thick. The surface layer is brown loam about 3 inches thick. The subsurface layer is light brown loam about 6 inches thick. The next layer is brown cobbly loam about 8 inches thick. The upper part of the subsoil is brown extremely stony sandy clay loam about 29 inches thick, and the lower part consists of brown extremely stony loam extending to 62 inches or more.

The permeability of the Frisco soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Clayburn loam on footslopes and mesas; small areas of Cryofibrists in depressions; and small areas of wet soils with loamy-skeletal control sections in depressions and drainageways. Included areas make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Abies lasiocarpa*-*Picea engelmannii*/*Vaccinium myrtillus* on the Frisco soil and *Deschampsia cespitosa*/*Carex spp.* on the Ute soil. The native vegetation consists of Englemann's spruce, subalpine fir, whortleberry, Thurber's fescue, nodding brome, elk sedge, mountain snowberry, bluegrass, and creeping juniper on the Frisco soil. Other plants that characterize the wetter parts of this unit are sedge, rush, tufted hairgrass, bluejoint, wheatgrass, shrubby cinquefoil, slender cinquefoil, and willow. The average annual understory production of air-dry vegetation is about 700 pounds per acre on the Frisco soil. The average annual production of air-dry vegetation is about 3,500 pounds per acre on the Ute soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for Englemann's spruce is 80 on the Frisco soil. It can produce about 76 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope.

The Frisco soil is well suited to the production of Englemann's spruce. The Ute soil is not suited to timber production. Timber productivity is estimated to be high on the Frisco soil. The main concerns in producing and harvesting timber are reforestation and the depth to a high water table of the Ute soil that interferes with road construction and harvesting operations. Conventional methods of harvesting timber are limited. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, and high rainfall. Low ground pressure equipment may be the only feasible method to harvest during the summer season. Harvesting activities can cause long term reduction in productivity if excess compaction occurs on wet soils.

The main limitations to reforestation on this soil are the depth to a high water table in the spring and summer on the Ute soil, and the content of cobbles and stones on the Frisco soil. Trees can be planted on the Frisco soil, but should not be planted on the Ute soil because of the water table. Planting nursery stock will hasten reforestation. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

Building unsurfaced roads on this unit is very limited due to the high water table of the Ute soil. Construction costs may be significantly higher than normal due to the need for building an adequate base. Proper design of road drainage systems and care in the placement of culverts will be essential to maintaining the road base. Road surfacing is almost always needed on the Ute soil.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and

understory plants. More uniform use of rangeland is aided by properly locating salt and by herding.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

This map unit is poorly suited to recreational development. The main limitations are the depth to a high water table on the unit and the slow permeability of the Ute soil.

The Ute soil is in capability subclass 6w, nonirrigated. The Frisco soil is in capability subclass 6e, nonirrigated.

830—Dressel-Jersey complex, 30 to 80 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes and canyon side slopes. The elevation is 7,600 to 10,500 feet. The average annual precipitation is 25 to 35 inches, the average annual air temperature is 34 to 40 degrees F., and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 55 percent Dressel gravelly loam, 30 percent Jersey very cobbly loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Dressel gravelly loam

The Dressel soil formed in colluvium and slope alluvium derived dominantly from sandstone and shale. Typically, the surface is covered with a mat of slightly decomposed twigs, leaves, and roots about 2 inches thick. The surface layer is very dark grayish brown gravelly loam about 6 inches thick. The lower part of the surface layer is very dark grayish brown very stony loam 11 inches thick. The subsurface layer is light gray very cobbly sandy clay loam about 4 inches thick. The upper 7 inches of the subsoil are light brownish gray very cobbly sandy clay loam. The lower 15 inches of the subsoil are light brownish gray and light gray extremely cobbly loam. The upper 8 inches of the substratum are light gray extremely cobbly loam, and the lower part consists of light brownish gray very cobbly loam to a depth of 62 inches or more.

The permeability of the Dressel soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Jersey very cobbly loam

The Jersey soil formed in colluvium and slope alluvium derived dominantly from sandstone and shale. Typically, the surface is covered with a mat of partially decomposed leaves, roots, and twigs 1 inch thick. The surface layer is very dark gray very cobbly loam about 7 inches thick. The next layer is dark grayish brown very cobbly clay loam about 5 inches thick. The upper part of the subsoil is brown very cobbly clay loam about 5 inches thick; the next part is very pale brown extremely stony clay loam about 8 inches thick; and the lower part is light brownish gray very cobbly clay loam about 11 inches thick. The substratum is light brownish gray very cobbly clay to a depth of 61 inches or more.

The permeability of the Jersey soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 5 percent soils with fine-loamy subsoils, 5 percent soils with light colored surface layers, 4 percent soils with bedrock above 60 inches, and small areas of Rock outcrop on breaks, and less sloping areas on structural benches. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus*. The native vegetation consists mainly of quaking aspen, common snowberry, Columbia needlegrass, nodding brome, Thurber's fescue, beardless wheatgrass, slender wheatgrass, Fendler's meadow-rue, American vetch, heartleaf arnica, Nevada pea, Woods' rose, and Richardson's geranium. The average annual understory production of air-dry vegetation is about 2,000 pounds per acre on the Dressel soil and about 1,800 pounds per acre on the Jersey soil.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for quaking aspen is 70 on the Dressel soil. It can produce about 39 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated high for this unit because of steep slopes and shale parent material.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Careful consideration of road systems and harvesting methods should be made to minimize erosion. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, and high rainfall.

This unit is well suited to the production of quaking aspen. Timber productivity is estimated to be high. Only the less sloping areas should be considered for timber harvesting. Conventional harvesting methods generally are restricted to slopes of less than 40 percent. Access to the steeper areas is limited. The steep slope limits the kinds of equipment that can be used in forest management.

The main limitations to reforestation on this unit are the content of cobbles and stones in the surface layers. Large stones limit rooting space and soil moisture, and interfere with planting operations. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest.

The main limitations to the building of unsurfaced roads on this unit are the steep slopes and high mass movement potential on the unit, and the high shrink-swell potential and low strength of the Jersey soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. The slope limits access by livestock and results in overgrazing of the less sloping areas.

Wildlife such as elk, mule deer, bear, hawks, eagles, coyotes, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by

livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes, the content of stones, and slow permeability in the Jersey soil. The slopes limit the use of this unit mainly to a few paths and trails, which should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

832—Storm extremely flaggy loam, 0 to 15 percent slopes

Map Unit Description

This very deep, well drained soil is on mesas and hills. The elevation is 10,000 to 11,500 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 32 to 38 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Storm extremely flaggy loam

The Storm soil formed in residuum derived dominantly from sandstone. Typically, the surface is covered with a mat of partially decomposed needles, twigs, and roots 2 inches thick. The surface layer is dark brown extremely flaggy loam 4 inches thick. The subsurface layer is pale brown extremely flaggy loam 7 inches thick. The upper part of the subsoil is pale brown extremely flaggy clay loam about 6 inches thick; the next part is light yellowish brown very gravelly clay loam about 12 inches thick; and the lower part is very pale brown extremely cobbly clay loam about 9 inches thick. The upper 8 inches of the substratum are brownish yellow very gravelly loam; the next 8 inches are very pale brown extremely gravelly loam; and the lower part has light yellowish brown extremely gravelly clay loam to a depth of 62 inches or more.

The permeability of the Storm soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is low. The content of rock fragments ranges from 35 to 80 percent.

Contrasting Inclusions

Included in this unit are about 8 percent soils with thick dark colored surface layers on the less sloping areas on mesas; small areas of soils that have fine textured subsoils on hillslopes; small areas that have clayey-skeletal subsoils on hillslopes; and small areas that are shallow or moderately deep over bedrock on ridges and breaks to drainageways. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa*-*Picea engelmannii*/*Vaccinium scoparium*. Some *Picea engelmannii*/*Vaccinium scoparium* also occurs. The native vegetation consists mainly of Englemann's spruce, subalpine fir, grouse whortleberry, Richardson's geranium, slender wheatgrass, mountain snowberry, Columbia needlegrass, nodding brome, sedge, bluegrass, American vetch, Fendler's meadow-rue, and elderberry. The average annual understory production of air-dry vegetation is about 800 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for Englemann's spruce is 84 on the Storm soil. It can produce about 82 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit because of the slope.

The Storm soil is well suited to the production of Englemann's spruce and subalpine fir. Timber productivity is estimated to be high. The main concerns in producing and harvesting timber are large stones in the soil. Stones in the surface can interfere with road construction and tree planting. Conventional methods of harvesting timber can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt and high rainfall. Harvesting some of the mature trees for lumber and thinning dense stands of younger trees for use as poles increases the growth rate of the rest of the stand and increases the understory vegetation.

The main limitation to reforestation on the Storm soil is the content of large stones. Large stones limit rooting space and soil moisture, and interfere with planting operations. After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. Planting nursery stock will hasten reforestation. The high content of rock fragments can make the planting of seedlings difficult. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitation for building unsurfaced roads on this unit is the content of stones in the soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants. More uniform use of rangeland is aided by properly locating salt and by herding.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the content of stones and the slopes that are over 8 percent. Paths and trails can be developed.

This map unit is in capability subclass 7s, nonirrigated.

834—Haycamp-Jersey complex, 30 to 80 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on mountain slopes and canyon side slopes. The elevation is 8,600 to 11,500 feet. The average annual precipitation is 30 to 40 inches, the average annual air temperature is 32 to 38 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 60 percent Haycamp cobbly clay loam, 25 percent Jersey very cobbly loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Haycamp cobbly clay loam

The Haycamp soil formed in colluvium and slope alluvium derived dominantly from sandstone and shale. Typically, the surface is covered with a mat of partly decomposed leaves, roots, and twigs 1 inch thick. Haycamp soil has about 2 percent stones on the surface. The surface layer is very dark brown cobbly clay loam about 4 inches thick. The subsurface layer is light gray cobbly clay about 8 inches thick. The upper part of the subsoil is pale brown cobbly clay about 8 inches thick; the next part is pale brown clay about 9 inches thick; and the lower part is very pale brown clay about 8 inches thick. The upper 18 inches of the substratum are light brownish gray gravelly clay. The lower part is light brownish gray very cobbly clay loam to a depth of 61 inches or more.

The permeability of the Haycamp soil is slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is high. Content of rock fragments ranges from 5 to 25 percent in the control section.

Jersey very cobbly loam

The Jersey soil formed in colluvium and slope alluvium derived dominantly from sandstone and shale. Typically, the surface is covered with a mat of partially decomposed leaves, roots, and twigs 1 inch thick. The surface layer is very dark gray very cobbly loam about 7 inches thick. The next layer is dark grayish brown very cobbly clay loam about 5 inches thick. The upper part of the subsoil is brown very cobbly clay loam about 5 inches thick; the next part is very pale brown extremely stony clay loam about 8 inches thick; and the lower part is light brownish gray very cobbly clay loam about 11 inches thick. The substratum is light brownish gray very cobbly clay to a depth of 61 inches or more.

The permeability of the Jersey soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate. Content of rock fragments range from 35 to 70 percent in the control section.

Contrasting Inclusions

Included in this unit are about 5 percent soils with thick dark surface layers on mountain slopes; about 5 percent soils with fine-loamy texture control sections on mountain slopes; small areas of soils with bedrock above 40 inches on ridges; and small areas of Rock outcrop on breaks. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa*-*Picea engelmannii*/*Vaccinium scoparium*. Some *Picea engelmannii*/*Vaccinium scoparium* also occurs. Quaking aspen areas have *Populus tremuloides*/*Symphoricarpos oreophilus*. The native vegetation consists mainly of Englemann's spruce, subalpine fir, quaking aspen, grouse whortleberry, common snowberry, slender wheatgrass, sedge, Richardson's geranium, American vetch, Nevada pea, Fendler's meadow-rue, heartleaf arnica, Woods' rose, Letterman's needlegrass, Thurber's fescue, and nodding brome. The average annual understory production of air-dry vegetation is about 800 pounds per acre on the Haycamp soil, and about 1,800 pounds per acre on the Jersey soil.

Soil Management Implications

This unit is used for wildlife habitat and timber production.

A representative site index for this map unit for Englemann's spruce is 90 on the Haycamp soil. It can produce about 91 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 90 years old.

The mass movement potential is rated high for this unit because of steep slopes.

The main concerns in producing and harvesting timber are reforestation and preventing erosion along roads and other places where vegetation has been removed. Only the less sloping areas should be considered for timber harvesting. Conventional harvesting methods generally are restricted to slopes of less than 40 percent. Access to the steeper areas is limited. The steep slope limits the kinds of equipment that can be used in forest management. Careful consideration of road systems and harvesting methods should be made to minimize erosion. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt and high rainfall.

The main limitations to reforestation on this unit are the clayey surface soils of the Haycamp soil and the content of cobbles in the soils of the unit that make tree planting difficult. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitations to the building of unsurfaced roads on this unit are the steep slopes of both soils and the high mass movement potential, low strength, and high shrink-swell potential of the Haycamp soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes, slow permeability, and the content of stones. The slopes limit the use of this soil mainly to a few paths and trails, which should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

835—Brumley loam, 0 to 15 percent slopes

Map Unit Description

This very deep, well drained soil is on terraces and mesas. The elevation is 6,800 to 7,200. The average annual precipitation is 12 to 14 inches, the average annual air temperature is 47 to 50 degrees F, and the average frost-free period is 100 to 120 days. The moisture regime is aridic-ustic and the temperature regime is mesic.

Brief Soil Description

Brumley loam

The Brumley soil formed in slope alluvium derived dominantly from sandstone. Typically, the surface layer is brown loam 2 inches thick. The upper 15 inches of the subsoil are brown clay loam, and the lower 23 inches are light brown clay loam. The substratum is pink loam to a depth of 60 inches or more.

The permeability of the Brumley soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent soils that are moderately deep to bedrock on the edges of drainageways; 5 percent Wetherill loam on mesas; and 5 percent soils with cobbly surfaces and more than 35 percent rock fragments in the profile on ridges. Wetherill soils have fine-silty subsoils. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Artemisia tridentata*-*Purshia tridentata*/*Elytrigia smithii*. Some areas have *Pinus edulis*-*Juniperus osteosperma*/*Artemisia tridentata*. The native vegetation on this unit is mainly western wheatgrass, prairie Junegrass, Indian ricegrass, muttongrass, basin big sagebrush, antelope bitterbrush, needleandthread, and bottlebrush squirreltail. Other important plants that characterize this unit are twoneedle pinyon and Utah juniper. The average annual production of air-dry vegetation is about 1,100 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

Use of planned grazing systems helps to maintain the quality and quantity of desirable vegetation and reduces erosion. More uniform distribution of livestock is aided by properly locating salt and stock water development, and by fencing and herding. If the condition of the range deteriorates, pinyon, juniper, and woody shrubs increase. Removal of pinyon and juniper increases the production of understory forage. Range seeding should be done in conjunction with removal of the overstory. The main limitation to reseeding on this unit is the limited amount of precipitation. Seeding late in fall helps to ensure that moisture in the soil will be adequate for the establishment of seedlings next spring. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribing burning or by chemical or mechanical methods may be subject to a greater hazard of erosion.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

This map unit is well suited to recreational development, especially on the lower slopes. The main limitation is the presence of slopes that are over 8 percent.

This map unit is in capability subclass 4e, nonirrigated.

860—Granath-Nortez complex, 0 to 15 percent slopes

Map Unit Description

This map unit is a complex of very deep and moderately deep, well drained soils on mesas and hills. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This unit consists of 55 percent Granath loam, 30 percent Nortez loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Granath loam

The Granath soil is very deep. It formed in eolian material derived from sandstone. Typically, the surface layer is brown loam about 2 inches thick. The upper part of the subsoil is brown loam about 13 inches thick; the next part is reddish brown loam about 5 inches thick; and the lower part is reddish brown clay loam that extends to 60 inches or more.

The permeability of the Granath soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Nortez loam

The Nortez soil is moderately deep. It formed in eolian material derived from sandstone. Typically, the surface layer is reddish brown loam about 3 inches thick. The next layer is reddish brown clay loam about 7 inches thick. The subsoil is yellowish red clay loam about 22 inches thick over bedrock. Hard sandstone is at a depth of 32 inches; however, the depth to hard sandstone generally ranges from 20 to 40 inches.

The permeability of the Nortez soils is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 5 percent Fivepine very stony loam on hillslopes and ridges; 5 percent Ormiston extremely stony loam on hillslopes; and 5 percent Fughes loam in drainageways. Fivepine soils are shallow. Ormiston soils have more than 35 percent rock fragments in the profile. Fughes soils have dark colored surface layers more than 16 inches thick. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Festuca arizonica/Muhlenbergia montana*. *Quercus gambelii/Symphoricarpos oreophilus* and *Artemisia tridentata/Stipa comata* occur in some areas. The native vegetation on this unit is mainly Arizona fescue, needlegrass, western wheatgrass, Parry's danthonia, and mountain muhly. Other plants that characterize this unit are Gambel oak, big sagebrush, antelope bitterbrush, needleandthread, mountain brome, and prairie Junegrass. Some areas have scattered ponderosa pine. The average annual production of air-dry vegetation is about 1,500 pounds per acre on the Granath soil and about 1,200 pounds per acre on the Nortez soil.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

Use of planned grazing systems helps to maintain the quality and quantity of desirable vegetation and reduces erosion. More uniform distribution of livestock is aided by properly locating stock water development and salt, and by fencing and herding. If the condition of the range deteriorates, Gambel oak and other woody shrubs increase. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribing burning or by chemical or mechanical methods may be subject to a greater hazard of erosion. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedling the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the slopes that are over 8 percent and the slow permeability of the Nortez soil. Paths and trails can be developed.

This map unit is in capability subclass 4e, nonirrigated.

861—Morapos loam, 0 to 15 percent slopes

Map Unit Description

This very deep, well drained soil is on mesas and fan remnants. The elevation is 7,100 to 8,000 feet. The average annual precipitation is 15 to 20 inches. The average annual air temperature is 41 to 45 degrees F, and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not affect the use or management of the unit. These include Granath loam and Pagoda loam. These similar soils make up about 10 percent of the total acreage; the percentage varies from one area to another.

Brief Soil Description

Morapos loam

The Morapos soil formed in alluvium and slope alluvium derived dominantly from sedimentary rocks. Typically, the surface layer is brown loam 3 inches thick. The upper 5 inches of the subsoil are brown clay loam, and the lower 14 inches are brown clay. The underlying material is yellowish brown to very pale brown clay loam to a depth of 60 inches or more.

The permeability of the Morapos soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 5 percent Arabrab loam on hillslopes and ridges and 5 percent Shawa loam in drainageways and on hillslopes. Arabrab soils are shallow over sandstone bedrock. Shawa soils have less than 35 percent clay in the subsoil. These inclusions make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Artemisia tridentata/Elytrigia smithii* and *Artemisia tridentata/Stipa comata*. The native vegetation on this unit consists mainly of basin big sagebrush, western wheatgrass, Arizona fescue, needleandthread, Gambel oak, and Utah serviceberry. Other common plants that characterize this unit are prairie Junegrass, muttongrass, and black sagebrush. The average annual production of air-dry vegetation is about 900 pounds per acre.

Soil Management Implications

This map unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on the Morapos soil are the low strength and the shrink-swell potential.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of vegetation for grazing. More uniform use of rangeland is aided by properly locating salt and by herding. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribing burning or by chemical or mechanical methods may be subject to a greater hazard of erosion. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be available in the spring for germination.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this map unit is used for recreation development, the main limitations are the slopes that are over 8 percent and the slow permeability. Paths and trails can be developed.

This map unit is in capability subclass 4e, nonirrigated.

862—Granath-Dolores-Fivepine complex, 0 to 15 percent slopes

Map Unit Description

This map unit is a complex of very deep to shallow, well drained soils on mesas and hills. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 41 to 45 degrees F., and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 40 percent Granath loam, 25 percent Dolores loam, 20 percent Fivepine flaggy loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Granath loam

The Granath soil is very deep. It formed in eolian material derived from sandstone. Typically, the surface layer is brown loam about 2 inches thick. The upper part of the subsoil is brown loam about 13 inches thick; the next part is reddish brown loam about 5 inches thick; and the lower part is reddish brown clay loam that extends to 60 inches or more.

The permeability of the Granath soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Dolores loam

The Dolores soil is very deep. It formed in slope alluvium derived dominantly from sandstone. Typically, the surface has a layer of organic material about 1 inch thick. The surface layer is reddish brown loam about 7 inches thick with about 1 to 3 percent stones on the surface. The upper part of the subsoil is reddish brown to yellowish red extremely bouldery clay loam about 16 inches thick; the next part is

yellowish red extremely stony clay about 25 inches thick; and the lower part is brown extremely stony clay to a depth of 61 inches or more.

The permeability of the Dolores soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Fivepine flaggy loam

The Fivepine soil is shallow. It formed in residuum and slope alluvium derived from sandstone. Typically, the surface layer is reddish brown flaggy loam about 3 inches thick with about 1 to 3 percent flagstones on the surface. The upper 9 inches of the subsoil are reddish brown flaggy clay loam, and the lower 3 inches are yellowish red flaggy clay. Hard fractured sandstone is at a depth of 15 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Fivepine soil is slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 7 percent Nortez loam on hillslopes; 5 percent Fughes loam in drainageways and on alluvial fans; and 3 percent Ararab loam on mesas, hillslopes, and ridges. Nortez soils are moderately deep. Fughes soils have thick dark colored surface layers. Ararab soils are shallow and have less than 35 percent clay in the subsoil. Included areas make up about 15 percent of the total acreage; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Festuca arizonica*/*Muhlenbergia montana* and *Artemisia tridentata*/*Festuca arizonica* on the Granath soil; *Quercus gambelii*/*Festuca arizonica* on the Dolores soil; and *Pinus ponderosa*/*Quercus gambelii* on the Fivepine soil. The native vegetation consists mainly of big sagebrush, Gambel oak, Arizona fescue, western wheatgrass, and needlegrass. Ponderosa pine and Rocky Mountain juniper occurs on the Fivepine soil. Other common plants that characterize this unit are prairie Junegrass, mountain brome, nodding brome, mountain muhly, Parry's danthonia, slender wheatgrass, bluegrass, pine dropseed, bottlebrush squirreltail, antelope bitterbrush, Utah serviceberry, and common snowberry. The average annual production of air-dry vegetation is about 1,500 pounds per acre on the Granath soil and about 900 pounds per acre on the Dolores soil. The average annual understory production of air-dry vegetation is about 800 pounds per acre on the Fivepine soil.

Soil Management Implications

This unit is used mostly for livestock grazing and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 67 on the Fivepine soil. It can produce about 52 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the content of large stones in the Dolores soil and the depth to bedrock of the Fivepine soil. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of vegetation for grazing. More uniform use of rangeland is aided by

properly locating salt and by herding. If the condition of the range deteriorates, woody shrubs and annual weeds increase. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community.

Areas where brush is managed by prescribed burning, chemical and mechanical methods may be subject to a greater hazard of erosion. If the range vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the content of large stones on the Dolores and Fivepine soils and the depth to bedrock of the Fivepine soil. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the content of large stones on the Dolores and Fivepine soils, the depth to bedrock of the Fivepine soil, and slopes that are over 8 percent. Areas could be developed on the Granath soil. Paths and trails can be developed.

The Granath soil is in capability subclass 4e, nonirrigated. The Dolores and Fivepine soils are in capability subclass 7s, nonirrigated.

863—Granath-Ormiston-Fivepine complex, 0 to 15 percent slopes

Map Unit Description

This map unit is a complex of very deep to shallow, well drained soils on mesas and hills. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 41 to 45 degrees F., and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 40 percent Granath loam, 25 percent Ormiston loam, 20 percent Fivepine flaggy loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Granath loam

The Granath soil is very deep. It formed in eolian material derived from sandstone. Typically, the surface layer is brown loam about 2 inches thick. The upper part of the subsoil is brown loam about 13 inches thick; the next part is reddish brown loam about 5 inches thick; and the lower part is reddish brown clay loam that extends to 60 inches or more.

The permeability of the Granath soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Ormiston loam

The Ormiston soil is deep. It formed in slope alluvium derived dominantly from sandstone, and in eolian material. Typically, the surface layer is brown loam about 7 inches thick with 1 to 3 percent stones on the surface. The upper part of the subsoil is reddish brown very stony heavy clay loam about 17 inches thick; the lower part is reddish brown stony clay loam about 8 inches thick. The substratum is pinkish white stony clay loam about 12 inches thick. Sandstone bedrock is at a depth of 44 inches; however, the depth to bedrock generally ranges from 40 to 60 inches.

The permeability of the Ormiston soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 40 to 60 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Fivepine flaggy loam

The Fivepine soil is shallow. It formed in residuum and slope alluvium derived from sandstone. Typically, the surface layer is reddish brown flaggy loam about 3 inches thick with about 1 to 3 percent flags on the surface. The upper 9 inches of the subsoil are reddish brown flaggy clay loam, and the lower 3 inches are yellowish red flaggy clay. Hard fractured sandstone is at a depth of 15 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Fivepine soil is slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 7 percent Nortez loam on hillslopes; 5 percent Fughes loam in drainageways; and 3 percent Arabrab loam on mesas, hillslopes, and ridges. Nortez soils are moderately deep. Fughes soils have thick dark colored surface layers. Arabrab soils are shallow and have less than 35 percent clay in the subsoil. Included areas make up about 15 percent of the total acreage; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Festuca arizonica*/*Muhlenbergia Montana*, *Artemisia tridentata*/*Festuca arizonica*, and *Quercus gambelii*/*Festuca arizonica* on the Granath and Ormiston soils; and *Pinus ponderosa*/*Quercus gambelii* on the Fivepine soil. The native vegetation consists mainly of Arizona fescue, western wheatgrass, needlegrass, Gambel oak, and big sagebrush. Ponderosa pine and Rocky Mountain juniper occur on the Fivepine soil. Other common plants that characterize this unit are prairie Junegrass, mountain brome, mountain muhly, Parry's danthonia, slender wheatgrass, muttongrass, pine dropseed, nodding brome, bottlebrush squirreltail, bluegrass, antelope bitterbrush, Utah serviceberry, common snowberry, and black sagebrush. Minor areas of twoneedle pinyon and Utah juniper occur on the drier parts of the unit. The average annual production of air-dry vegetation is about 1,500 pounds per acre on the Granath soil and about 900 pounds per acre on the Ormiston soil. The average annual understory production is about 800 pounds per acre on the Fivepine soil.

Soil Management Implications

This unit is used mostly for livestock grazing and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 67 on the Fivepine soil. It can produce about 52 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the content of large stones in the Ormiston soil and the depth to bedrock of the Fivepine soil. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of vegetation for grazing. More uniform use of rangeland is aided by

properly locating salt and by herding. If the condition of the range deteriorates, woody shrubs and annual weeds increase. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community.

Areas where brush is managed by prescribed burning, chemical and mechanical methods may be subject to a greater hazard of erosion. If the range vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the content of large stones on the Ormiston and Fivepine soils and the depth to bedrock of the Fivepine soil. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the content of large stones on the Ormiston and Fivepine soils, the depth to bedrock of the Fivepine soil, and slopes that are over 8 percent. Areas could be developed on the Granath soil. Paths and trails can be developed.

The Granath soil is in capability subclass 4e, nonirrigated. The Ormiston and Fivepine soils are in capability subclass 7s, nonirrigated.

890—Tamarron-Frisco complex, 30 to 60 percent slopes

Map Unit Description

This map unit is a complex of moderately deep and very deep, well drained soils on mountain slopes and ridges. The elevation is 8,000 to 10,600 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 34 to 38 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 45 percent Tamarron loam, 35 percent Frisco loam, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Tamarron loam

The Tamarron soil is moderately deep. It formed in slope alluvium and colluvium derived dominantly from sandy shale and sandstone. Typically, the surface is covered with a mat of organic material of needles, leaves, and twigs about 3 inches thick. The surface layer is light brownish gray loam about 6 inches thick. The upper 11 inches of the subsoil are light brown very channery clay loam, and the lower 10 inches are pale brown very flaggy loam. The substratum is pale brown extremely flaggy loam about 9 inches thick over weathered platy sandy shale. The depth to bedrock ranges from 20 to 40 inches from the mineral soil surface.

The permeability of the Tamarron soil is moderately slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 20 to 40. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Frisco loam

The Frisco soil is very deep. It formed in slope alluvium and colluvium derived dominantly from sandstone and sandy shale. Typically, the surface is covered with a mat of twigs, needles, and bark about 2 inches thick. The surface layer is brown loam about 3 inches thick. The subsurface layer is light brown loam about 6 inches thick, and the next layer is brown cobbly loam about 8 inches thick. The upper part of the

subsoil is brown extremely stony sandy clay loam about 29 inches thick; the lower part is brown extremely stony loam extending to 62 inches or more.

The permeability of the Frisco soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Snowdon loam on mountain slopes and ridges; 5 percent Bucklon loam on mountain slopes and ridges; and 5 percent Haviland loam on mountain slopes. Snowdon and Bucklon soils are shallow. Haviland soils have less than 35 percent rock fragments in the profile.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of subalpine fir, Englemann's spruce, quaking aspen, whortleberry, mountain snowberry, and mountain brome. Other important plants that characterize this unit are bluegrass, nodding brome, kinnikinnick, Thurber's fescue, Letterman's needlegrass, spike trisetum, smallflowered woodrush, elk sedge, elderberry, gooseberry currant, cinquefoil, creeping juniper, and Nevada pea. The average annual understory production of air-dry vegetation is about 400 pounds per acre on the Tamarron soil and about 700 pounds per acre on the Frisco soil.

Soil Management Implications

This unit is used mainly for timber production, wildlife habitat, and limited livestock grazing.

A representative site index for this map unit for Englemann's spruce is 78 on the Tamarron soil. It can produce about 73 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 110 years old.

The mass movement potential is rated moderate for this unit because of the slope and underlying shale.

This unit is well suited to the production of Englemann's spruce. Timber productivity is estimated to be high. The main concerns in producing and harvesting timber are reforestation and road construction. Conventional harvesting methods generally are restricted to slopes of less than 40 percent. Access to the steeper areas is limited. The steepness of slope limits the kinds of equipment that can be used in forest management. Careful consideration of road systems and harvesting methods should be made to minimize erosion. Tree harvesting may be restricted during periods of high snow accumulations, snowmelt, or high rainfall.

The main limitations to reforestation on this unit are the slopes and the content of rock fragments. The high content of rock fragments can make the planting of seedlings difficult. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitations to building unsurfaced road on this unit are the depth to bedrock in the Tamarron soil, the content of rock fragments, and the slopes. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve understory vegetation. The slope limits access by livestock and results in overgrazing of the less sloping areas.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from

overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitation is the steep slopes. These slopes limit the use of the unit mainly to a few paths and trails, which should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

891—Tamarron-Frisco complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of moderately deep and very deep, well drained soils on mountain slopes and ridges. The elevation is 8,000 to 10,600 feet. The average annual precipitation is 30 to 45 inches, the average annual air temperature is 34 to 38 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

This map unit consists of 45 percent Tamarron loam, 40 percent Frisco loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Tamarron loam

The Tamarron soil is moderately deep. It formed in slope alluvium and colluvium derived dominantly from sandy shale and sandstone. Typically, the surface is covered with a mat of organic material of needles, leaves, and twigs about 3 inches thick. The surface layer is light brownish gray loam about 6 inches thick. The upper 11 inches of the subsoil are light brown very channery clay loam, and the lower 10 inches are pale brown very flaggy loam. The substratum is pale brown extremely flaggy loam about 9 inches thick over weathered platy sandy shale. The depth to bedrock ranges from 20 to 40 inches from the mineral soil surface.

The permeability of the Tamarron soil is moderately slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Frisco loam

The Frisco soil is very deep. It formed in slope alluvium and colluvium derived dominantly from sandstone and sandy shale. Typically, the surface is covered with a mat of twigs, needles, and bark about 2 inches thick. The surface layer is brown loam about 3 inches thick. The subsurface layer is light brown loam about 6 inches thick. The next layer is brown cobbly loam about 8 inches thick. The upper part of the subsoil is brown extremely stony sandy clay loam about 29 inches thick; the lower part is brown extremely stony loam extending to 62 inches or more.

The permeability of the Frisco soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Snowdon loam on mountain slopes and ridges; small areas of Bucklon loam on mountain slopes and ridges; and small areas of Haviland loam on mountain slopes. Snowdon and Bucklon soils are shallow. Haviland soils have less than 35 percent rock fragments in the profile. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of subalpine fir, Englemann's spruce, quaking aspen, whortleberry, mountain snowberry, and mountain brome. Other important plants that characterize this unit are bluegrass, nodding brome, kinnikinnick, Thurber's fescue, Letterman's needlegrass, spike trisetum, smallflowered woodrush, elk sedge, elderberry, gooseberry currant, cinquefoil, Nevada pea, and creeping juniper. The average annual understory production of air-dry vegetation is about 400 pounds per acre on the Tamarron soil and about 700 pounds per acre on the Frisco soil.

Soil Management Implications

This unit is used mainly for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for Englemann's spruce is 78 on the Tamarron soil. It can produce about 73 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 110 years old.

The mass movement potential is rated low for this unit because of the slope and the high content of rock fragments.

This unit is well suited to the production of Englemann's spruce. Timber productivity is estimated to be high. The main concerns in producing and harvesting timber are reforestation and road construction. Conventional methods of harvesting timber can be used. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitation to reforestation on this unit is the high content of rock fragments, which can make the planting of seedlings difficult. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Englemann's spruce, subalpine fir, and lodgepole pine.

The main limitations to building unsurfaced roads on this unit are the depth to bedrock in the Tamarron soil and the content of rock fragments. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and some forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve understory vegetation. Stock water development and fencing will help to improve livestock distribution and the production of understory vegetation. More uniform use of rangeland is aided by properly locating salt and by herding.

Wildlife such as elk, mule deer, bear, blue grouse, hawks, eagles, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitation is the slope, which limits most of the unit to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

901—Granath-Zoltay-Nortez complex, 0 to 15 percent slopes

Map Unit Description

This map unit is a complex of very deep and moderately deep, well drained soils on mesas and hills. The elevation is 7,600 to 8,500 feet. The average annual precipitation is 17 to 19 inches, the average annual air temperature is 41 to 45 degrees F, and the average frost-free period is 75 to 90 days. The moisture and temperature regimes are ustic and frigid, respectively.

This unit consists of 45 percent Granath loam, 25 percent Zoltay clay loam, 20 percent Nortez loam, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Granath loam

The Granath soil is very deep. It formed in eolian material derived from sandstone. Typically, the surface layer is brown loam about 2 inches thick. The upper part of the subsoil is brown loam about 13 inches thick; the next part is reddish brown loam about 5 inches thick; and the lower part is reddish brown clay loam that extends to 60 inches or more.

The permeability of the Granath soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Zoltay clay loam

The Zoltay soil is very deep. It formed in slope alluvium derived dominantly from sandstone and shale. Typically the surface layer is brown clay loam about 6 inches thick; the next layer is dark grayish brown clay loam about 8 inches thick. The upper 9 inches of the subsoil are very dark grayish brown cobbly clay; the next 6 inches are yellowish brown cobbly clay; the next 17 inches of the subsoil are yellowish brown very cobbly clay loam; and the lower part is light yellowish brown cobbly clay loam to a depth of 60 inches or more.

The permeability of the Zoltay soil is slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of erosion is severe. The potential of shrink-swell is moderate.

Nortez loam

The Nortez soil is moderately deep. It formed in eolian material derived from sandstone. Typically, the surface layer is reddish brown loam about 3 inches thick. The next layer is reddish brown clay loam about 7 inches thick. The subsoil is yellowish red clay loam about 22 inches thick over bedrock. Hard sandstone is at a depth of 32 inches; however, the depth to bedrock generally ranges from 20 to 40 inches.

The permeability of the Nortez soils is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 5 percent Fivepine very stony loam, on hillslopes and ridges; 3 percent Ormiston extremely stony loam on hillslopes; and 2 percent Fughes loam in drainageways. Fivepine soils are shallow over sandstone. Ormiston

soils have more than 35 percent rock fragments in the profile. Fughes soils have dark surface layers more than 16 inches thick. Included areas make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Festuca arizonica/Muhlenbergia montana*. The native vegetation on this unit is mainly Arizona fescue, needleandthread, western wheatgrass, and mountain muhly. Other plants that characterize this unit are Parry's danthonia, mountain brome, muttongrass, needlegrass, Gambel oak, mountain big sagebrush, antelope bitterbrush, and prairie Junegrass. Some areas have scattered ponderosa pine. The average annual production of air-dry vegetation is about 1,600 pounds per acre on the Granath soil, about 1,000 pounds per acre on the Zoltay soil, and about 1,200 pounds per acre on the Nortez soil.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

Use of planned grazing systems helps to maintain the quality and quantity of desirable vegetation and reduces erosion. More uniform distribution of grazing is aided by properly locating stock water development and salt, and by fencing and herding. If the condition of the range deteriorates, Gambel oak and other woody shrubs increase. Brush management improves deteriorated areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribing burning or by chemical or mechanical methods may be subject to a greater hazard of erosion. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedling the next spring.

Wildlife such as elk, mule deer, rabbits, and squirrels utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Wildlife obtains food from forbs, shrubs, and grasses.

This unit is well suited to recreational development on the lower slopes. The main limitations are the slopes that are over 8 percent and the slow permeability in the Nortez and Zoltay soils. Paths and trails can be developed.

The Granath and Nortez soils are in capability subclass 4e, nonirrigated. The Zoltay soil is in capability subclass 6e, nonirrigated.

903—Anvik loam, 12 to 45 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 8,500 to 10,000 feet. The average annual precipitation is 25 to 32 inches, the average annual air temperature is 36 to 42 degrees F., and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Anvik loam

The Anvik soil formed in slope alluvium derived mostly from sandstone and shale. Typically, the surface is covered with a mat of needles and twigs about 1 inch thick. The surface layer is dark grayish brown loam about 10 inches thick. The subsurface layer is light yellowish brown loam about 11 inches thick. The upper 9 inches of the subsoil are brown clay loam, and the lower 14 inches are yellowish brown clay loam. The substratum is yellowish brown sandy clay loam to a depth of 61 inches or more.

The permeability of the Anvik soil is moderate. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Weminuche loam and 4 percent Scotch loam, both on mountain slopes; and small areas of Rock outcrop. Weminuche soils have light colored surface layers. Scotch soils are shallow. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Abies concolor-Pseudotsuga menziesii/Symphoricarpos oreophilus* and *Abies lasiocarpa-Picea engelmannii/Carex geyeri*. Some *Populus tremuloides/Symphoricarpos oreophilus* occurs in aspen areas that lack evergreen trees. The native vegetation on this unit consists mainly of quaking aspen, white fir, Rocky Mountain Douglas-fir, subalpine fir, and Englemann's spruce. Other important plants that characterize this unit are common snowberry, elk sedge, Thurber's fescue, Arizona fescue, mountain brome, bluegrass, spike trisetum, and Oregon grape. The average annual understory production of air-dry vegetation is about 1,000 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for quaking aspen is 66 on the Anvik soil. It can produce about 36 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit.

The main concerns in producing and harvesting timber are reforestation, and preventing water erosion along roads and other places where vegetative cover has been removed. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall. Conventional harvesting methods can be used.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are Rocky Mountain Douglas-fir, Englemann's spruce, lodgepole pine and white fir. Quaking aspen will usually regenerate from roots after harvest.

The main limitation to the building of unsurfaced roads is the slope. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, blue grouse, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover

If this unit is used for recreational development, the main limitation is the slope. Development is limited mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

904—Beje fine sandy loam, 3 to 25 percent slopes

Map Unit Description

This shallow, well drained soil is on hills and ridges. The elevation is 7,100 to 7,800 feet. The average annual precipitation is 15 to 17 inches, the average annual air temperature is 42 to 45 degrees F, and the average frost-free period is 80 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not to affect the use or management of the unit. These include Fivepine flaggy loam. These similar soils make up about 5 percent of the total acreage; the percentage varies from one area to another.

Brief Soil Description

Beje fine sandy loam

The Beje soil formed in slope alluvium and residuum derived dominantly from sandstone. Typically, the surface layer is brown fine sandy loam about 6 inches thick. The subsoil is brown clay loam about 8 inches thick over hard fractured sandstone. The depth to bedrock ranges from 10 to 20 inches.

The permeability of the Beje soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 4 percent Nortez loam, 3 percent Granath loam, 2 percent Fughes loam, and small areas of Rock outcrop, all on hillslopes. Fughes and Granath soils are very deep. Nortez soils are moderately deep. Included areas make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus edulis-Juniperus osteosperma/Cercocarpus montanus*. The native vegetation on this unit consists mainly of twoneedle pinyon, Utah juniper, true mountain mahogany, and blue grama. Other important plants that characterize this unit are muttongrass, Indian ricegrass, prairie Junegrass, squaw apple, Gambel oak, and black sagebrush. The average annual understory production of air-dry vegetation is about 400 pounds per acre.

Soil Management Implications

This unit is used for wildlife habitat and limited livestock grazing.

The mass movement potential is rated low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the depth to bedrock and the content of large stones. To stabilize grades, road cuts and fills and other disturbed areas should be provided with water bars and reseeded.

Removal of pinyon and juniper increases the production of understory forage. Range seeding should be done in conjunction with removal of the overstory. Careful management is needed to prevent excessive grazing on this unit because it is difficult to revegetate. More uniform distribution of grazing is aided by properly location stock water development and salt and by fencing and herding. If the range vegetation is

seriously deteriorated, seeding is needed. The main limitation for seeding is the shallow depth to bedrock. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, and squirrels utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Wildlife obtains food from forbs, shrubs, and grasses.

If this unit is used for recreational development, the main limitations are the depth to bedrock and the slope. Paths and trails can be developed.

This map unit is in capability subclass 6s, nonirrigated.

905—Cryaquolls, 0 to 3 percent slopes

Map Unit Description

This very deep, poorly drained soil is on flood plains and valley floors. The elevation is 8,500 to 8,700 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 34 to 38 degrees F, and the average frost-free period is 50 to 75 days. The moisture and temperature regimes are aquic and cryic, respectively.

Brief Soil Description

Cryaquolls

The Cryaquolls soil formed in alluvium derived from mixed sources. In a reference pedon, the surface layer is very dark grayish brown and grayish brown loam about 12 inches thick. The underlying material, to a depth of 60 inches or more, is pale brown and yellowish brown stratified extremely gravelly loam and sandy loam that has yellowish brown iron concentrations throughout.

The permeability of the Cryaquolls soil is moderate. The available water capacity is moderate. The hydrologic group is D. The effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 6 to 20 inches from April through August. Runoff is low, and the hazard of water erosion is slight. The potential of shrink-swell is low. This soil is subject to brief periods of flooding from April through July.

Contrasting Inclusions

Included in this unit is about 5 percent of moderately well drained soils on the outer edges of the map unit on slightly higher areas.

Vegetation

The dominant plant association is *Deschampsia cespitosa*/*Carex spp.* The native vegetation on this unit consists mainly of tufted hairgrass, sedge, slender wheatgrass and willows. Other important plants that characterize this unit are Baltic rush, shrubby cinquefoil, narrowleaf cottonwood and California false hellebore. The average annual production of air-dry vegetation is about 3,700 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated very low for this unit because of the slope.

The high water table promotes the vigorous growth of water tolerant plants. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. The main limitations for seeding are the depth to a high water table and the hazard of flooding.

Wildlife such as elk, mule deer, coyote, beaver, and waterfowl utilize this unit. Management for wildlife should include protection from overgrazing by livestock,

prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover. Nearby forested areas provide cover for some of the wildlife.

This map unit is poorly suited to recreational development. The main limitations are the depth to a high water table and the hazard of flooding.

This map unit is in capability subclass 6w, nonirrigated.

906—Archuleta loam, 12 to 65 percent slopes

Map Unit Description

This shallow, well drained soil is on mountain slopes, hills, and ridges. The elevation is 7,500 to 8,500 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is 40 to 45 degrees F., and the average frost-free period is 90 to 110 days. The moisture and temperature regimes are ustic and frigid, respectively.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as to not affect the use or management of the unit. These include Sanchez very stony sandy clay loam on ridges. These similar soils make up about 10 percent of the total acreage; the percentage varies from one area to another.

Brief Soil Description

Archuleta loam

The Archuleta soil formed in residuum and slope alluvium derived dominantly from shale and sandstone. Typically, the surface layer is light brownish gray loam about 3 inches thick. The underlying material is brown clay loam to a depth of 16 inches. Shale bedrock is at a depth of 16 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Archuleta soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Pinacol loam on hills; 4 percent Hesperus loam in drainageways; and small areas of Herm loam on hills. The Pinacol soils have more than 35 percent rock fragments in the profile. Herm and Hesperus soils are very deep and have dark colored surface layers. Included areas make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation on this unit consists mainly of ponderosa pine, Gambel oak, bluegrass, and Arizona fescue. Other important plants that characterize this unit are prairie Junegrass, antelope bitterbrush, common snowberry, true mountain mahogany, Saskatoon serviceberry, mountain muhly, mountain brome, and a few twoneedle pinyon and Rocky Mountain juniper. The average annual understory production of air-dry vegetation is about 1,200 pounds per acre.

Soil Management Implications

This unit is used for wildlife habitat, timber production, and limited livestock grazing.

A representative site index for this map unit for ponderosa pine is 45 on the Archuleta soil. It can produce about 34 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 60 years old.

The mass movement potential is rated low for this unit because of bedrock.

The main concerns in producing and harvesting timber are reforestation and controlling erosion along roads and other places where vegetation has been removed. Conventional harvesting methods generally are restricted to slopes of less than 40 percent. Access to the steeper areas is limited. The steep slopes limit the kinds of equipment that can be used in forest management. Careful consideration of road systems and harvesting methods should be made to minimize erosion. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitations to reforestation on this unit are the steep slopes and shallow soils. Brushy plants such as Gambel oak limit natural regeneration of ponderosa pine. The shallow depth to bedrock can make the planting of seedlings difficult. Among the trees that are suitable for planting is ponderosa pine. Grazing in harvested areas should be deferred for at least 2 years to assure development of sufficient plant cover to protect the soil from erosion.

The main limitations to the building of unsurfaced roads on this unit are the steep slopes and the depth to bedrock. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Stock water development and fencing will help to improve livestock distribution and the production of native vegetation. Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. If the condition of the range and understory vegetation deteriorates, Gambel oak increases. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning, chemical or mechanical methods may be subject to a greater hazard of erosion. The slope limits access by livestock and results in overgrazing of the less sloping areas.

Wildlife such as elk, mule deer, rabbits, and squirrels utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Wildlife obtains food from forbs, shrubs, and grasses.

If this map unit is used for recreational development, the main limitations are the steep slopes and the depth to bedrock. These slopes limit the use of the unit mainly to a few paths and trails, which should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

907—Archuleta-Sanchez complex, 12 to 65 percent slopes

Map Unit Description

This map unit is a complex of shallow, well drained soils on mountain slopes, hills, and ridges. The elevation is 7,300 to 8,500 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is 40 to 45 degrees F., and the average frost-free period is 90 to 110 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 45 percent Archuleta loam, 30 percent Sanchez very stony sandy clay loam, and 25 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Archuleta loam

The Archuleta soil formed in residuum and slope alluvium derived from shale and sandstone. Typically, the surface layer is light brownish gray loam about 3 inches thick. The underlying material is brown clay loam to a depth of 16 inches. Shale bedrock is at a depth of 16 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Archuleta soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Sanchez very stony sandy clay loam

The Sanchez soil formed in residuum derived from sandstone. Typically, the surface layer is pale brown very stony sandy clay loam about 5 inches thick. The subsoil is light brownish gray very stony clay loam about 6 inches thick. The next layer is light brownish gray stony sandy clay loam about 4 inches thick over bedrock. Sandstone bedrock is at a depth of 15 inches; however, the depth to bedrock generally ranges from 11 to 20 inches.

The permeability of the Sanchez soil is moderately slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 11 to 20 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 7 percent Pinacol loam on hills; 7 percent Hesperus loam in drainageways; 7 percent Goldbug very stony fine sandy loam on mountain slopes; small areas of Herm loam on hills; and small areas of Rock outcrop. The Pinacol soils have more than 35 percent rock fragments in the profile. Herm and Hesperus soils are very deep and have dark colored surface layers. Goldbug soils are very deep and have fine textured subsoils. Included areas make up about 25 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation on this unit consists mainly of ponderosa pine, Gambel oak, bluegrass, and Arizona fescue. Other important plants that characterize this unit are prairie Junegrass, antelope bitterbrush, common snowberry, true mountain mahogany, Saskatoon serviceberry, mountain brome, mountain muhly, elk sedge, and a few twoneedle pinyon and Rocky Mountain juniper. The average annual understory production of air-dry vegetation is about 1,200 pounds per acre on the Archuleta soil and about 600 pounds per acre on the Sanchez soil.

Soil Management Implications

This unit is used for wildlife habitat, timber production, and limited livestock grazing.

A representative site index for this map unit for ponderosa pine is 45 on the Archuleta soil. It can produce about 34 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 60 years old.

The mass movement potential is rated low for this unit because of the bedrock.

The main concerns in producing and harvesting timber are reforestation and controlling erosion along roads and other places where vegetation has been

removed. Conventional harvesting methods generally are restricted to slopes of less than 40 percent. Access to the steeper areas is limited. The steep slopes limit the kinds of equipment that can be used in forest management. Careful consideration of road systems and harvesting methods should be made to minimize erosion. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The main limitations to reforestation on this unit are the steep slopes and the shallow soils. Brushy plants such as Gambel oak limit natural regeneration of Ponderosa pine. The high content of rock fragments can make the planting of seedlings difficult. Among the trees that are suitable for planting is ponderosa pine. Grazing in harvested areas should be deferred for at least 2 years to assure development of sufficient plant cover to protect the soil from erosion.

The main limitations to the building of unsurfaced roads on this unit are the steep slopes and the depth to bedrock. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Stock water development and fencing will help to improve livestock distribution and the production of native vegetation. If the condition of the range and understory vegetation deteriorates, Gambel oak increases. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning, chemical or mechanical methods may be subject to a greater hazard of erosion. The slope limits access by livestock and results in overgrazing of the less sloping areas.

Wildlife such as elk, mule deer, rabbits, and squirrels utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Wildlife obtains food from forbs, shrubs, and grasses.

If this map unit is used for recreational development, the main limitations are the steep slopes, depth to bedrock, and the content of stones in the Sanchez soil. These slopes limit the use of the unit mainly to a few paths and trails, which should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

908—Adel loam, 5 to 30 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 9,000 to 9,500 feet. The average annual precipitation is 25 to 28 inches, the average annual air temperature is 35 to 40 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Adel loam

The Adel soil formed in slope alluvium derived from mixed sources. Typically, the surface layer is dark grayish brown loam about 14 inches thick. The next layer is dark grayish brown loam about 22 inches thick. The substratum is brown clay loam to a depth of 60 inches or more.

The permeability of the Adel soil is moderate. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Ryman loam on footslopes and about 5 percent Wander very cobbly loam on toeslopes. Ryman soils have fine textured control sections. Wander soils have more than 35 percent rock fragments in the profile. These inclusions make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Festuca thurberi/Vicia americana-Lathyrus leucanthus*. The native vegetation on this unit consists mainly of Thurber's fescue, Colombia needlegrass, and mountain brome. Other important plants that characterize this unit are American vetch, elk sedge, beardless wheatgrass, Fendler's meadow-rue, Nevada pea, California false hellebore, and a few small patches of quaking aspen. The average annual production of air-dry vegetation on the Adel soil is about 3,000 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit.

This unit is well suited to range production. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of vegetation for grazing. More uniform use of rangeland is aided by properly locating salt and by herding.

Wildlife such as elk and mule deer utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Wildlife obtains food from forbs, shrubs, and grasses, and use nearby wooded areas for cover.

If this map unit is used for recreational development, the main limitation is the presence of slopes that are over 8 percent. Campgrounds and picnic areas can be developed on lower slopes. The slopes limit development of most areas of the unit to paths and trails, and drainage should be provided them. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

909—Adel loam, moist, 15 to 50 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 9,000 to 9,500 feet. The average annual precipitation is 28 to 30 inches, the average annual air temperature is 35 to 40 degrees F., and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Adel loam

The Adel soil formed in slope alluvium derived from mixed sources. Typically, the surface layer is dark grayish brown loam about 14 inches thick. The next layer is dark grayish brown loam about 22 inches thick. The substratum is brown clay loam to a depth of 60 inches or more.

The permeability of the Adel soil is moderate. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Ryman loam on footslopes; about 4 percent Wander very cobbly loam on toeslopes; and small areas of Bucklon loam mountain slopes. Ryman soils have fine textured control sections. Wander soils have more than 35 percent rock fragments in the profile. Bucklon soils are shallow over shale. Included areas make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Populus tremuloides/Symphoricarpos oreophilus*. The native vegetation on this unit consists mainly of quaking aspen and common snowberry. Other important plants that characterize this unit are Thurber's fescue, mountain brome, slender wheatgrass, western wheatgrass, Nevada pea, and Fendler's meadow-rue. The average annual understory production of air-dry vegetation is about 3,000 pounds per acre.

Soil Management Implications

This unit is used for timber production, wildlife habitat, and livestock grazing.

A representative site index for this map unit for quaking aspen is 66 on the Adel soil. It can produce about 36 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 100 years old.

The mass movement potential is rated low for this unit.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Conventional methods of harvesting timber can be used.

This unit is well suited to the production of quaking aspen. Grazing in harvested areas should be deferred for at least 2 years to ensure development of sufficient plant cover to protect the soil from erosion. Quaking aspen will usually regenerate from roots after harvest.

The main limitation to the building of unsurfaced roads on this unit is the hazard of erosion on the steeper slopes. Roads and landings can be protected from erosion by constructing water bars and seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Stock water development and fencing will help to improve livestock distribution and the production of vegetation for grazing. More uniform use of range and understory vegetation is aided by properly locating salt and by herding.

Wildlife such as elk, mule deer, rabbits, and squirrels utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Wildlife obtains food and cover from forbs, shrubs, grasses, and trees.

If this map unit is used for recreational development, the main limitation is the steep slopes, which limit development of most areas of the unit to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

917—Chris very stony loam, 9 to 25 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 8,500 to 10,000 feet. The average annual precipitation is 30 to 40 inches, the average annual air temperature is 36 to 40 degrees F., and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not to affect the use or management of the unit. These include Needleton stony loam. These similar soils make up about 10 percent of the total acreage; the percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Chris very stony loam

The Chris soil formed in slope alluvium derived mostly from sandstone. Typically, the surface is covered with a mat of partly decomposed needles and leaves 1 inch thick. The surface layer is pinkish gray very stony loam about 12 inches thick. The subsurface layer is pinkish gray gravelly sandy clay loam and reddish brown gravelly clay loam about 10 inches thick. The upper part of the subsoil is light reddish brown very cobbly clay loam and pinkish gray very cobbly loam about 8 inches thick. The lower part of the subsoil is light reddish brown very cobbly clay loam about 11 inches thick. The substratum is light reddish brown very cobbly sandy clay loam to a depth of 61 inches or more.

The permeability of the Chris soil is slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this map unit are about 5 percent soils that are moderately deep over sandstone on mountain slopes.

Vegetation

The dominant plant associations are *Abies lasiocarpa-Picea engelmannii/Carex geyeri* and *Populus tremuloides/Symphoricarpos oreophilus*. The native vegetation on this unit consists mainly of Englemann's spruce, subalpine fir, white fir, quaking aspen, and ponderosa pine. Other plants that characterize this unit are Gambel oak, snowberry, elk sedge, Arizona fescue, mountain brome, western wheatgrass, mountain muhly, bluegrass, nodding brome, spike trisetum, heartleaf arnica, Saskatoon serviceberry, and rose. The average annual understory production of air-dry vegetation on the Chris soil is about 700 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for white fir is 60 on the Chris soil. It can produce about 128 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 70 years old.

The mass movement potential is rated low for this unit because of the slope, and stones and cobbles in the soil.

Timber productivity is estimated to be moderate on the Chris soil. The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Tree

harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The high content of rock fragments in the surface can make the planting of seedlings difficult. Hand planting of nursery stock is usually necessary to establish or improve a stand. Brushy plants such as Gambel oak and snowberry limit natural regeneration. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting are lodgepole pine, white fir, Englemann's spruce, and Rocky Mountain Douglas-fir.

The main limitations to the building of unsurfaced roads are the content of stones and cobbles in the soil and the slopes. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of vegetation useable to livestock.

Wildlife such as elk, mule deer, rabbits, and squirrels utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Wildlife obtains food and cover from trees, forbs, shrubs, and grasses of the unit.

If this map unit is used for recreational development, the main limitations are the slopes and the content of stones. The slopes limit use of the unit mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

919—Clayburn loam, 3 to 12 percent slopes

Map Unit Description

This map unit consists of very deep, well drained soils on footslopes and toeslopes of mountains. The elevation is 8,500 to 9,500 feet. The average annual precipitation is 30 to 35 inches, the average annual air temperature is 36 to 40 degrees F, and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Clayburn loam

The Clayburn soil formed in slope alluvium derived mostly from sandstone and shale. Typically, the surface layer is grayish brown and dark grayish brown loam about 10 inches thick. The subsoil is dark grayish brown clay loam about 21 inches thick. The substratum is light brown sandy clay loam to a depth of 60 inches or more.

The permeability of the Clayburn soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Wander extremely stony loam on toeslopes and 5 percent soils that are extremely bouldery below very steep mountain slopes. Wander soils have more than 35 percent rock fragments in the profile.

Included soils make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Festuca arizonica*/*Muhlenbergia montana*. Some *Danthonia parryi*/*Festuca arizonica* also occurs. The native vegetation on this unit consists mainly of Arizona fescue, Parry's danthonia, mountain brome, mountain muhly, and slender wheatgrass. Other important plants that characterize this unit are bluegrass, serviceberry, and Gambel oak. The average annual production of air-dry vegetation is about 1,500 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Livestock grazing should be managed so that the desired balance of preferred species is maintained in the plant community. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Range seeding is suitable if the range is in poor condition. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants. More uniform use of rangeland is aided by properly locating salt and by herding.

Wildlife such as elk, mule deer, rabbits, and squirrels utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife. Nearby forested areas provide cover for some of the wildlife.

This map unit is well suited to recreational development on the lower slopes. The main limitation is the slopes that are over 8 percent. Paths and trails can be developed.

This map unit is in capability subclass 4e, nonirrigated.

920—Clayburn cobbly loam, 6 to 25 percent slopes

Map Unit Description

This map unit consists of very deep, well drained soils on mountain slopes. The elevation is 8,500 to 9,500 feet. The average annual precipitation is 30 to 35 inches, the average annual air temperature is 36 to 40 degrees F, and the average frost-free period is 60 to 80 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Clayburn cobbly loam

The Clayburn soil formed in slope alluvium derived from sandstone and shale. Typically, the surface layer is dark grayish brown cobbly loam about 18 inches thick. The subsoil is brown sandy clay loam about 25 inches thick. The substratum is brown loam to a depth of 60 inches or more.

The permeability of the Clayburn soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Wander extremely stony loam on toeslopes; 5 percent Nordicol very stony loam on mountain slopes; and about 5 percent Frisco stony loam on mountain slopes. Wander, Nordicol and Frisco soils all have more than 35 percent rock fragments in the profile. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Populus tremuloides*/*Symphoricarpos oreophilus* and *Pseudotsuga menziesii*/*Amelanchier alnifolia*. The native vegetation on this unit consists mainly of quaking aspen, Rocky Mountain Douglas-fir, white fir, Englemann's spruce, Arizona fescue, bluegrass, mountain brome, and Parry's danthonia. Other important plants that characterize this unit are Gambel oak, slender wheatgrass, elk sedge, Nevada pea, and Oregongrape. The average annual understory production of air-dry vegetation is about 1,200 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for Rocky Mountain Douglas-fir is 75 on the Clayburn soil. It can produce about 62 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the slope.

The main concerns in producing and harvesting timber are road construction and erosion control along roads and landings and reforestation. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

The content of rock fragments can make the planting of seedlings difficult. Hand planting of nursery stock is usually necessary to establish or improve a stand. Among the trees that are suitable for planting are Englemann's spruce and lodgepole pine. Other trees suited to this unit are Rocky Mountain Douglas-fir and subalpine fir. Quaking aspen will usually regenerate from roots after harvest.

The main limitations to the building of unsurfaced roads on this soil are the stoniness in the surface layer and the low strength. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Grazing should be delayed until the soil is firm and the more desirable forage plants have achieved sufficient growth to withstand grazing pressure. Deferred grazing will help to hasten revegetation and to improve areas in poor condition.

Wildlife such as elk, mule deer, rabbits, and squirrels utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the slopes and the content of stones. The slopes limit most of the unit to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

926—Ustolls-Rock outcrop complex, 40 to 90 percent slopes

Map Unit Description

This map unit is a complex of shallow to very deep, well drained soils and Rock outcrop, on mountain slopes and canyon side slopes. The elevation is 6,600 to 8,600 feet. The average annual precipitation is 15 to 22 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 80 to 110 days. The moisture and temperature regimes are ustic and frigid, respectively.

This unit consists of 45 percent Ustolls, 40 percent Rock outcrop, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Ustolls

Ustolls are highly variable. The soils formed in slope alluvium and colluvium derived from sandstone and shale. In a representative profile, the surface layer is dark grayish brown stony loam about 11 inches thick. The next layer is brown stony loam about 7 inches thick. The subsoil is light brown very cobbly clay loam about 24 inches thick. The substratum is reddish yellow very stony clay to a depth of 60 inches or more. The depth to bedrock ranges from 10 to 60 inches or more.

The permeability of the Ustolls soil is moderately slow in the subsoil and slow in the substratum. The available water capacity is low to moderate. The hydrologic group is B. The effective rooting depth is 10 to 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low in the upper part of the profile and moderate in the lower part.

Rock outcrop

Rock outcrop consists of exposed sandstone and conglomerate bedrock that generally occupies positions at the higher edge of the map unit. It supports little vegetation. Areas with Rock outcrop are rated steep to very steep, and include many vertical cliffs from 5 to 50 feet high.

Contrasting Inclusions

Included in this unit are about 8 percent Ceek very flaggy clay loam and 7 percent soils with lighter colored surface layers, both on canyon side slopes. Ceek soils have thin dark colored surface layers. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Quercus gambelii*/*Amelanchier utahensis* at the lower elevations and *Pinus ponderosa*/*Quercus gambelii* at higher elevations. The present vegetation at lower elevations is Gambel oak, Utah serviceberry, western wheatgrass, prairie Junegrass, Indian ricegrass, and elk sedge. At higher elevations ponderosa pine, Arizona fescue, snowberry, and a few Rocky Mountain Douglas-fir trees occur. The average annual understory production of air-dry vegetation is about 600 pounds per acre on the Ustolls soil.

Soil Management Implications

This map unit is used for wildlife habitat and limited livestock grazing.

The mass movement potential is rated high for this unit because of steep slopes and rock fall potential.

The main limitations to the building of unsurfaced roads on this unit are the slopes, the content of large stones, and the depth to bedrock.

The main limitations to livestock grazing on this unit are the content of large stones and the slopes. Large stones limit the rooting space and water-holding capacity of the soil. This unit is generally not suited to reseeding because of stones and steep slopes. Steep slopes result in excessive use of the lower slopes.

Wildlife such as elk, mule deer, rabbits, squirrels, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

This map unit is poorly suited to recreational development. It is limited mainly by the steep slopes, the content of stones, the shallow depth to bedrock in many places, and rock outcrops.

The Ustolls soil is in capability subclass 7e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

930—Fortlewis-Rock outcrop complex, 6 to 25 percent slopes

Map Unit Description

This map unit is a complex of moderately deep, well drained soils and Rock outcrop on mountain slopes. The elevation is 7,500 to 8,500 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is 41 to 45 degrees F., and the average frost-free period is 90 to 110 days. The moisture and temperature regimes are ustic and frigid, respectively.

This unit consists of 45 percent Fortlewis stony fine sandy loam, 35 percent Rock outcrop, and 20 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Fortlewis stony fine sandy loam

The Fortlewis soil formed in slope alluvium derived dominantly from sandstone and shale. Typically, the surface is covered with a mat of organic material of needles and leaves about 1 inch thick. The surface layer is brown stony fine sandy loam about 3 inches thick. The subsurface layer is pinkish gray stony fine sandy loam about 8 inches thick. The upper 5 inches of the subsoil are reddish brown clay loam and light brown sandy clay loam; the next 10 inches are light reddish brown clay; and the lower part of the subsoil is reddish yellow clay to a depth of about 39 inches. Fractured sandstone bedrock is at a depth of 39 inches; however, the depth to bedrock generally ranges from 20 to 40 inches from the mineral soil surface.

The permeability of the Fortlewis soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Rock outcrop

Rock outcrop consists of exposed areas of sandstone.

Contrasting Inclusions

Included in this unit are about 10 percent Goldbug very stony fine sandy loam on mountain slopes; 5 percent Valto very stony fine sandy loam on ridges; and 5 percent Nordicol very stony sandy loam on steeper areas of mountain slopes. Goldbug soils are very deep. Valto soils are shallow. Nordicol soils have more than 35 percent rock

fragments in the profile. Included areas make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation on this unit consists mainly of ponderosa pine, Gambel oak, Arizona fescue, and mountain muhly. Other important plants that characterize this unit are prairie Junegrass, true mountain mahogany, mountain brome, western wheatgrass, pine dropseed, and bluegrass. The average annual understory production of air-dry vegetation is about 850 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 65 on the Fortlewis soil. It can produce about 50 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the slope.

This unit is well suited to the production of ponderosa pine. The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. Brushy plants such as Gambel oak limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting is ponderosa pine.

Proper design of road drainage systems and care in the placement of culverts help to control erosion. The depth to bedrock can interfere with road construction. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory vegetation.

Wildlife such as elk, mule deer, bear, coyote, squirrels, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover.

If this map unit is used for recreational development, the main limitations are the slopes, the content of stones, and rock outcrops. The slopes limit most of the unit to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Fortlewis soil is in capability subclass 7s, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

934—Ceek very flaggy clay loam, 10 to 40 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 7,800 to 8,200 feet. The average annual precipitation is 17 to 19 inches, the average annual

air temperature is 41 to 43 degrees F., and the average frost-free period is 70 to 90 days. The moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Creek very flaggy clay loam

The Creek soil formed in slope alluvium and colluvium derived from sandstone and shale. Typically, the surface is covered with an organic layer about 1 inch thick. The surface layer is very dark grayish brown very flaggy clay loam about 5 inches thick. The subsurface layer is brown very cobbly clay loam about 8 inches thick. The subsoil is brown very cobbly clay loam about 9 inches thick. The upper part of the substratum is weak red clay about 9 inches thick, and the lower part is reddish gray clay to a depth of 61 inches or more.

The permeability of the Creek soil is slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 7 percent Zoltay soils on toeslopes; 5 percent soils with thick dark surface layers and occurring on the less sloping areas; and small areas of Rock outcrop occurring at the top of the mountain slopes. Zoltay soils have thick dark colored surface layers. Included soils make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation on this unit consists mainly of ponderosa pine, Gambel oak, prairie Junegrass, muttongrass, mountain muhly, and elk sedge. The average annual understory production of air-dry vegetation is about 1,200 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 73 on the Creek soil. It can produce about 59 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit.

This unit is well suited to the production of Ponderosa pine. The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. Brushy plants such as Gambel oak limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting is ponderosa pine.

The main limitations to building unsurfaced roads on this soil is the high clay content, high shrink-swell potential, and low strength of the lower horizons; the content of stones and cobbles in the upper horizons; and the slopes in the unit. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be stabilized and protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development

and fencing will help to improve livestock distribution and the production of range and understory vegetation.

Wildlife such as elk, mule deer, rabbits, and squirrels utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the slope, the slow permeability, and the content of flagstones in the surface. The slope limits development of most areas to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7e, nonirrigated.

937—Herm loam, 6 to 25 percent slopes

Map Unit Description

This very deep, well drained soil is on hills. The elevation is 8,000 to 8,500 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 40 to 44 degrees F., and the average frost-free period is 90 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Herm loam

The Herm soil formed in slope alluvium derived dominantly from shale and sandstone. Typically, the surface layer is dark grayish brown loam about 6 inches thick. The next layer is dark brown clay loam about 7 inches thick. The upper 4 inches of the subsoil are grayish brown clay loam, and the lower 28 inches are brown clay loam. The substratum is grayish brown clay loam to a depth of 60 inches or more.

The permeability of the Herm soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 5 percent Pinacol stony loam on mesas; 5 percent Goldbug very stony loam on hillslopes; and 5 percent Ohwiler loam in swales. Pinacol soils have more than 35 percent rock fragments in the profile. Goldbug soils have light colored surface layers. Ohwiler soils have fine-loamy subsoils. These inclusions make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation on this unit consists mainly of ponderosa Pine, Gambel oak, Arizona fescue, prairie Junegrass, mountain muhly, and bluegrass. Other important plants that characterize this unit are mountain brome, elk sedge, common snowberry, Saskatoon serviceberry, and true mountain mahogany. The average annual understory production of air-dry vegetation on the Herm soil is about 1,300 pounds per acre.

Soil Management Implications

This unit is used mainly for livestock grazing, timber production, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 72 on the Herm soil. It can produce about 58 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the slope.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. Brushy plants such as Gambel oak limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting is ponderosa pine.

The main limitations to the building of unsurfaced roads on these soils are the high clay content, low strength, and shrink-swell potential. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Spoil from excavations is subject to rill and gully erosion and to sloughing. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory vegetation. If the condition of the understory deteriorates, Gambel oak and snowberry will increase. Brush management improves areas that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning, chemical, or mechanical methods may be subject to a greater hazard of erosion. If the range or understory vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, and squirrels utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide cover and food.

If this map unit is used for recreational development, the main limitations are the slopes that are over 8 percent and the slow permeability. The slopes limit most of the unit to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 6e, nonirrigated.

939—Ohwiler loam, 3 to 12 percent slopes

Map Unit Description

This very deep, well drained soil is in mountain valleys. The elevation is 7,700 to 8,500 feet. The average annual precipitation is 20 to 25 inches, the average annual air temperature is 40 to 45 degrees F., and the average frost-free period is 80 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Ohwiler loam

The Ohwiler soil formed in slope alluvium derived from mixed sources. Typically, the surface layer is dark grayish brown loam about 14 inches thick. The upper 31 inches of the subsoil are dark grayish brown clay loam, and the lower 10 inches of the subsoil are brown loam. The substratum is pale brown loam to a depth of 60 inches or more.

The permeability of the Ohwiler soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit is about 10 percent Herm loam on low terraces. Herm soils have fine textured subsoils.

Vegetation

The dominant plant association is *Danthonia parryi*/*Festuca arizonica*. *Quercus gambelii*/*Symphoricarpos oreophilus*/*Amelanchier alnifolia* occurs on some areas. The native vegetation on this unit consists mainly of Arizona fescue, Parry's danthonia, needleandthread, and western wheatgrass. Other important plants that characterize this unit are mountain brome, bluegrass, prairie Junegrass, Gambel oak, common snowberry, and Utah serviceberry. The average annual production of air-dry vegetation is about 1,800 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range vegetation. More uniform use of rangeland is aided by properly locating salt and by herding. If the condition of the range deteriorates, Gambel oak increases. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, bear, and coyote utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Wildlife obtain food from forbs, shrubs, and grasses. Nearby forested areas provide cover for some of the wildlife.

This map unit is well suited to recreational development on the lower slopes. The main limitation is the presence of slopes that are over 8 percent.

This map unit is in capability subclass 4e, nonirrigated.

940—Horsethief stony fine sandy loam, 20 to 65 percent slopes

Map Unit Description

This very deep, well drained soil is on mountain slopes. The elevation is 9,000 to 10,000 feet. The average annual precipitation is 25 to 35 inches, the average annual air temperature is 34 to 38 degrees F, and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively

Brief Soil Description

Horsethief stony fine sandy loam

The Horsethief soil formed in slope alluvium and colluvium derived dominantly from sandstone. Typically, the surface is covered with a mat of needles, twigs, and bark about 2 inches thick. The surface layer is pale brown stony fine sandy loam about 3 inches thick. The subsurface layer is pale brown and light yellowish brown

stony fine sandy loam about 19 inches thick. The upper 8 inches of the subsoil are very pale brown extremely stony fine sandy loam and brown extremely stony sandy clay loam. The lower 17 inches of the subsoil are brown extremely stony clay loam. The substratum is brown very stony clay loam to a depth of 62 inches or more.

The permeability of the Horsethief soil is moderately slow. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Frisco cobbly loam, 5 percent Haviland loam, and 5 percent Graysill loam, all on mountain slopes. Frisco soils have argillic horizons with their upper boundary above 24 inches. Haviland soils have less than 35 percent rock fragments in the subsoil. Graysill soils are moderately deep and have less than 35 percent rock fragments in the subsoil. These inclusions make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Abies lasiocarpa-Picea engelmannii/Vaccinium myrtillus*. The native vegetation on this unit consists mainly of subalpine fir, Englemann's spruce, Rocky Mountain Douglas-fir, quaking aspen, and white fir. Other important plants that characterize this unit are whortleberry, Thurber's fescue, mountain brome, bluegrass, mountain snowberry, spike trisetum, elk sedge, and elderberry. The average annual understory production of air-dry vegetation is about 1,650 pounds per acre.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for Englemann's spruce is 75 on the Horsethief soil. It can produce about 69 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 110 years old.

The mass movement potential is rated low for this unit because of the high content of rock fragments.

The main concerns in producing and harvesting timber are reforestation and road construction due to the stony soils and steep slopes. Tree harvesting may be restricted during periods of high snow accumulation, snowmelt, or high rainfall.

After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. Brushy plants such as Gambel oak and snowberry limit natural regeneration. Planting nursery stock will hasten reforestation. Tree planting is difficult due to the stony surface textures. Among the trees that are suitable for planting are Englemann's spruce and lodgepole pine. Quaking aspen will usually regenerate from roots after harvest.

The main limitations to building unsurfaced roads on this unit are the content of stones in the soil and the slopes. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and many forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory plants.

Wildlife such as elk, mule deer, bear, coyote, squirrels, and blue grouse utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide food and cover.

If this map unit is used for recreational development, the main limitations are the steep slopes and the content of stones. The slopes limit use of the unit mainly to a few paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

This map unit is in capability subclass 7s, nonirrigated.

942—Fivepine-Pino complex, 0 to 15 percent slopes

Map Unit Description

This map unit is a complex of shallow to moderately deep, well drained soils on mesas. The elevation ranges from 7,400 to 8,500 feet. The average annual precipitation is 17 to 20 inches. The average annual air temperature is 41 to 45 degrees F, and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This unit consists of 50 percent Fivepine loam, 35 percent Pino loam, and 15 percent included soils. There are some soils within the mapping unit which are classified differently than the major components, but are similar enough so as not affect the use or management of the unit. These include Beje loam. These similar soils make up about 5 percent of the total acreage; the percentage varies from one area to another. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Fivepine loam

The Fivepine soil is shallow. It formed in residuum and slope alluvium derived dominantly from sandstone. Typically, the surface layer is reddish brown loam about 3 inches thick. The upper 9 inches of the subsoil are reddish brown flaggy clay loam, and the lower 3 inches are yellowish red flaggy clay. Hard fractured sandstone is at a depth of 15 inches. The depth to bedrock ranges from 10 to 20 inches. The Beje soil has less clay in the subsoil.

The permeability of the Fivepine soil is slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Pino loam

The Pino soil is moderately deep. It formed in slope alluvium derived dominantly from interbedded sandstone and shale. Typically, the surface is covered with a mat of decomposed organic material about 1 inch thick. The surface layer is dark grayish brown loam about 3 inches thick. The next layer is brown loam about 8 inches thick. The upper 9 inches of the subsoil are brown clay loam, and the lower 8 inches are reddish yellow clay. The substratum is brownish yellow clay about 5 inches thick. Sandstone and shale bedrock is at a depth of about 34 inches. The depth to bedrock ranges from 20 to 40 inches from the mineral soil surface.

The permeability of the Pino soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Contrasting Inclusions

Included in this unit are about 5 percent Granath loam on hills and 5 percent Ceek very flaggy loam on the steeper slopes. Granath and Ceek soils are very deep. These inclusions make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation consists of ponderosa pine, Gambel oak, western wheatgrass, Arizona fescue, and pine dropseed. Other common plants that characterize this unit are prairie Junegrass, needlegrass, mountain muhly, mountain brome, bluegrass, and bottlebrush squirreltail, common snowberry, and Utah serviceberry. The average annual understory production of air-dry vegetation is about 800 pounds per acre on the Fivepine soil and about 1,200 pounds per acre on the Pino soil.

Soil Management Implications

This unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 67 on the Fivepine soil. It can produce about 52 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the slope.

The main concern in producing and harvesting timber is reforestation and depth to bedrock. Plant competition delays natural regeneration but does not prevent the eventual development of a fully stocked, normal stand of trees. Timber productivity is estimated to be low.

After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. Brushy plants such as Gambel oak limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting is ponderosa pine. The shallow depth to bedrock on the Fivepine soil limits rooting space and soil moisture, and interferes with planting operations.

The main limitations for building unsurfaced roads on this unit are the shallow depth to bedrock of the Fivepine soil and the low strength and the shrink-swell potential of the Pino soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory vegetation.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this unit is used for recreational development, the main limitations are the depth to bedrock of the Fivepine soil, the slow permeability, and slopes that are over 8 percent. Campgrounds and picnic areas can be developed on the Pino soil. Paths and trails can be developed.

The Fivepine soil is in capability subclass 6s, nonirrigated. The Pino soil is in capability subclass 4e, nonirrigated.

945—Nizhoni-Arabrab-Rock outcrop complex, 1 to 50 percent slopes

Map Unit Description

This map unit is a complex of shallow and very shallow, well drained soils, and Rock outcrop on mesas, hills, ridges, structural benches, and escarpments. The

elevation is 6,600 to 7,200 feet. The average annual precipitation is 13 to 15 inches, the average annual air temperature is 45 to 49 degrees F, and the average frost-free period is 110 to 125 days. The moisture regime is aridic-ustic and the temperature regime is mesic for both soils.

This map unit consists of 35 percent Nizhoni sandy loam, 30 percent Arabrab fine sandy loam, 30 percent Rock outcrop, and 5 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Nizhoni sandy loam

The Nizhoni soil formed in residuum derived dominantly from sandstone. The Nizhoni soil is very shallow. Typically, the surface layer is reddish brown sandy loam about 4 inches thick. The next layer is reddish brown sandy loam to a depth of about 8 inches. Hard sandstone is at a depth of 8 inches; however, the depth to bedrock generally ranges from 5 to 15 inches.

The permeability of the Nizhoni soil is moderately rapid. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 5 to 10 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Arabrab fine sandy loam

The Arabrab soil is shallow. It formed in residuum derived dominantly from sandstone. Typically, the surface layer is light reddish brown fine sandy loam about 3 inches thick. The subsoil is reddish brown sandy clay loam about 13 inches thick. Hard sandstone is at a depth of 16 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Arabrab soil is moderate. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Rock outcrop

Rock outcrop consists of exposed sandstone bedrock. Areas are gently sloping to steep; they occur as 10 to 50 foot escarpments and as scattered outcrops.

Contrasting Inclusions

Included in this unit are small areas of moderately deep loamy soils on structural benches; small areas of deep loamy soils in swales; and small areas of shallow soils that lack argillic horizons on structural benches. Included areas make up about 5 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus edulis-Juniperus osteosperma/Cercocarpus montanus*. *Pinus edulis-Juniperus osteosperma/Oryzopsis hymenoides* also occurs on similar landscapes. The native vegetation consists mainly of twoneedle pinyon and Utah juniper. Other common native plants include western wheatgrass, Indian ricegrass, true mountain mahogany, big sagebrush, blue grama, galleta, bottlebrush squirreltail, antelope bitterbrush, and squaw apple. The average annual understory production of air-dry vegetation is about 200 pounds per acre on the Nizhoni soil and about 250 pounds per acre on the Arabrab soil.

Soil Management Implications

This map unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of shallow depth to bedrock.

The main limitations to the building of unsurfaced roads are the depth to bedrock and the rock outcrops.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range vegetation. Removal of pinyon and juniper increases the production of understory forage. Range seeding should be done in conjunction with removal of the overstory. The main limitations to reseeding are the steep slopes, shallow depth to bedrock, rock outcrops, and low precipitation. Seeding late in the fall will help ensure that soil moisture will be available in the spring for seed germination.

This unit provides wildlife habitat for mule deer, elk, rabbits, hawks, and eagles.

Wildlife such as elk, mule deer, rabbits, squirrels, hawks, and eagles utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover.

This map unit is poorly suited to recreational development. It is limited mainly by the depth to bedrock, steep slopes, and rock outcrops.

The Nizhoni and Arabrab soils are in capability subclass 7s, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

950—Pescar fine sandy loam

Map Unit Description

The Pescar soil is a very deep, somewhat poorly drained soil on flood plains. The slopes are 0 to 2 percent. The elevation is 7,100 to 8,000 feet. The average annual precipitation is 18 to 22 inches, the average annual air temperature is 42 to 45 degrees F., and the average frost-free period is 90 to 110 days. The moisture regime is aquic and the temperature regime is frigid.

Brief Soil Description

Pescar fine sandy loam

The Pescar soil formed in stratified alluvium derived from mixed sources. Typically, the surface layer is light brownish gray fine sandy loam about 8 inches thick. The upper 12 inches of the underlying material are light brownish gray fine sandy loam stratified with loam and loamy fine sand; the lower part consists of light brownish gray very gravelly sand that extends to 60 inches or more.

Permeability is moderately rapid. The available water capacity is low. The hydrologic group is C. The effective rooting depth is limited by a seasonal high water table that is at a depth of 10 to 20 inches from April through June. Runoff is very low, and the hazard of water erosion is slight. This soil is subject to brief periods of flooding from April through September. The shrink-swell potential is low.

Contrasting Inclusions

Included in this unit are about 15 percent Riverwash and open water in the stream course; small areas that lack the sandy-skeletal substratum above 40 inches; and small areas that have better drainage on slightly higher areas. Inclusions make up about 20 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Deschampsia cespitosa*/*Carex* spp. The native vegetation consists mainly of tufted hairgrass, slender wheatgrass, and sedge. Other important plants that characterize this unit are Baltic rush, narrow leaf cottonwood

trees and willows. The average annual production of air-dry vegetation is about 3,000 pounds per acre.

Soil Management Implications

This unit is used for wildlife habitat and livestock grazing.

The mass movement potential is rated very low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the hazard of flooding and the depth to a high water table.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range plants. More uniform use of rangeland is aided by properly locating salt and by herding.

Wildlife such as elk, mule deer, and waterfowl utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation and water areas provide food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the hazard of flooding and the depth to a high water table.

This map unit is in capability subclass 4w, nonirrigated.

951—Endoaquolls, 0 to 3 percent slopes

Map Unit Description

This very deep, poorly drained soil is on flood plains, and in drainageways. The elevation is 7,800 to 8,200 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is 43 to 45 degrees F., and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are aquic and frigid, respectively.

Brief Soil Description

Endoaquolls

The Endoaquolls soil formed in alluvium derived from igneous and sedimentary rocks. These soils are extremely variable. In a reference pedon, the surface layer is grayish brown loam about 4 inches thick. The next layer is brown fine sandy loam about 8 inches thick. The upper part of the underlying material is brown fine sandy loam and loam about 16 inches thick with iron concentrations throughout. The lower part is dark yellowish brown extremely cobbly sand with iron concentrations throughout to a depth of 60 inches or more.

The permeability of the Endoaquolls soil is moderate. The available water capacity is low. The hydrologic group is D. The effective rooting depth is 20 to 60 inches. Runoff is low, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 6 to 18 inches from April through June. This soil is subject to long periods of flooding from April through June. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this map unit are small areas of well drained medium textured soils on higher positions along the edges of the map unit, and small areas of Haplofibrists in depressions. Haplofibrists are organic soils. Included soils make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Deschampsia cespitosa*/*Carex* spp. The native vegetation consists of tufted hairgrass, Nebraska sedge, and Baltic rush. Other

important plants that characterize this unit are bluegrass, redtop, willow, and iris. The average annual production of air-dry vegetation is about 3,000 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated very low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the hazard of flooding and the depth to a high water table.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. More uniform distribution of livestock is aided by properly locating stock water development and salt, and by fencing and herding. The areas are usually not suitable for reseeding.

This unit provides wildlife habitat for waterfowl. The suitability for wetland wildlife is good.

This map unit is poorly suited to recreational development. The main limitations are the hazard of flooding and the depth to a high water table.

This map unit is in capability subclass 5w, nonirrigated.

955—Umbarg-Winner-Tesajo complex, 0 to 2 percent slopes

Map Unit Description

This map unit is a complex of very deep, moderately well drained to somewhat poorly drained soils on flood plains and terraces. The elevation is 5,800 to 7,100 feet. The average annual precipitation is 13 to 16 inches, the average annual air temperature is 47 to 52 degrees F., and the average frost-free period is 100 to 120 days. The moisture regimes are ustic for Umbarg and Tesajo soils and aquic for the Winner soil. The temperature regime is mesic for all three soils.

This map unit consists of 35 percent Umbarg loam, 30 percent Winner clay loam, 20 percent Tesajo gravelly sandy loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Umbarg loam

The Umbarg soil is moderately well drained. It formed in alluvium derived from mixed sources. Typically, the upper part of the surface layer is dark grayish brown loam about 2 inches thick. The lower part of the surface layer is dark grayish brown clay loam about 10 inches thick. The next layer is dark grayish brown loam about 21 inches thick. The next layer is grayish brown loam with strong brown masses of iron accumulation about 9 inches thick. The substratum is grayish brown very gravelly loam with strong brown masses of iron accumulation to a depth of 60 inches or more.

The permeability of the Umbarg soil is moderately slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 36 to 60 inches from April through September. This soil is subject to brief periods of flooding from March through May. The potential of shrink-swell is low.

Winner clay loam

The Winner soil is somewhat poorly drained. It formed in alluvium derived from mixed sources. Typically the surface layer is dark grayish brown clay loam about 4 inches thick. The underlying material is dark grayish brown and brown clay loam

about 27 inches thick. The substratum is brown very stony sandy clay loam to a depth of 60 inches or more. The soil has iron concentrations throughout.

The permeability of the Winner soil is moderately slow. The available water capacity is moderate. The hydrologic group is D. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. A seasonal high water table is at a depth of 6 inches to 24 inches from April through June. This soil is subject to brief periods of flooding from March through May. The potential of shrink-swell is low.

Tesajo gravelly sandy loam

The Tesajo soils are moderately well drained. It formed in alluvium derived from mixed sources. Typically, the surface layer very dark grayish brown gravelly sandy loam about 3 inches thick. The next layer is dark grayish brown very cobbly sandy loam about 8 inches thick. The next layer is dark grayish brown extremely cobbly sandy loam about 8 inches thick. The next layer is grayish brown extremely cobbly loamy sand about 17 inches thick. The next layer is dark grayish brown extremely cobbly sandy loam to a depth of 60 inches or more.

The permeability of the Tesajo soil is moderately rapid. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very low, and the hazard of water erosion is slight. A high water table is at a depth of 48 to 72 inches from April through August. This soil is subject to brief periods of flooding from March through May. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Payter loam on alluvial fans; 5 percent Fluvaquents on flood plains; and 5 percent Riverwash and water in the stream course. Payter soils are well drained and have coarse-loamy control sections. Fluvaquents are poorly drained and have light colored surface layers. Included areas make up about 15 percent of the total acreage; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Deschampsia cespitosa*/*Carex spp.* and *Populus angustifolia*/*Salix exigua*. The native vegetation on this map unit consists mostly of cottonwood trees, willows, western wheatgrass, sedge, tufted hairgrass, and mountain brome. Other common plants that characterize this unit include Baltic rush, Kentucky bluegrass, foxtail barley, and Rocky Mountain iris. The average annual production of air-dry vegetation is about 2600 pounds per acre on the Umbarg soil, about 2000 pounds per acre on the Winner soil and about 2000 pounds per acre on the Tesajo soil.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the wetness and the hazard of flooding.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water is normally available from streams in the map unit. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that the soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, and waterfowl utilize this unit. Management for wildlife should include protection from overgrazing by livestock,

prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for wildlife.

If this map unit is used for recreational development, the main limitations are the hazard of flooding, except where protected by an upstream dam, and the depth to a high water table in the Winner soil. The Umbarg soil is well suited to picnic areas and play grounds. Paths and trails can be developed.

The Umbarg soil is in capability subclass 3w, nonirrigated and irrigated. The Winner soil is in capability subclass 6w, nonirrigated and irrigated. The Tesajo soil is in capability subclass 4w, nonirrigated and irrigated.

956—Ormiston-Granath complex, 1 to 12 percent slopes

Map Unit Description

This map unit is a complex of deep and very deep, well drained soils on mesas and hills. The surface is covered with 1 to 3 percent stones. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 40 to 45 degrees F., and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 50 percent Ormiston extremely stony loam, 35 percent Granath loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Ormiston extremely stony loam

The Ormiston soil is deep. It formed in slope alluvium and eolian material derived dominantly from sandstone. Typically, the surface layer is brown extremely stony loam about 3 inches thick with about 1 to 3 percent stones on the surface. The next layer is brown very stony clay loam about 4 inches thick. The upper part of the subsoil is reddish brown very stony clay loam about 17 inches thick, and the lower part is reddish brown stony clay loam about 8 inches thick. The substratum is pinkish white stony clay loam about 12 inches thick. Sandstone bedrock is at a depth of 44 inches.

The permeability of the Ormiston soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 40 to 60 inches. The depth to bedrock is 40 to 60 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Granath loam

The Granath soil is very deep. It formed in eolian material derived from sandstone. Typically, the surface layer is brown loam about 2 inches thick. The upper part of the subsoil is brown loam about 13 inches thick; the next part is reddish brown loam about 5 inches thick; and the lower part is reddish brown clay loam that extends to 60 inches or more.

The permeability of the Granath soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 7 percent Nortez loam on hills; 5 percent Fughes loam in drainageways and on alluvial fans; and 3 percent Arabrab loam on hills and ridges. Nortez soils are moderately deep. Fughes soils have dark colored surface

layers more than 16 inches thick. Arabrab soils are shallow. These inclusions make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Quercus gambelii*/*Festuca arizonica* on the Ormiston soil and *Artemisia tridentata*/*Festuca arizonica* on the Granath soil. Some *Pinus ponderosa*/*Quercus gambelii* occurs on more moist sites and some north slopes. The native vegetation consists mainly of Gambel oak, western wheatgrass, Arizona fescue, and needlegrass. Other common plants that characterize this unit are Parry's danthonia, mountain muhly, slender wheatgrass, prairie Junegrass, muttongrass, mountain brome, big sagebrush, antelope bitterbrush, Utah serviceberry, and common snowberry. Minor areas of ponderosa pine occur in more moist parts of the unit. The average annual production of air-dry vegetation is about 900 pounds per acre on the Ormiston soil, and about 1,500 pounds per acre on the Granath soil.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the content of large stones in the Ormiston soil, and the high clay content and the shrink-swell potential of the Granath soil.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of vegetation for grazing. More uniform use of rangeland is aided by properly locating salt and by herding.

If the condition of the range deteriorates, woody shrubs and annual weeds increase. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribed burning, chemical, or mechanical methods, may be subject to a greater hazard of erosion. If the range vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the content of large stones and the limited rainfall. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, and squirrels utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby wooded areas provide food and cover.

If this map unit is used for recreational development, the main limitations are the large stones on the Ormiston soil and the slopes that are over 8 percent. Camp areas and picnic areas can be developed on the lower slopes of the Granath soil. Paths and trails can be developed.

The Ormiston soil is in capability subclass 7s, nonirrigated. The Granath soil is in capability subclass 4e, nonirrigated.

958—Sheek-Archuleta-Rock outcrop complex, 25 to 80 percent slopes

Map Unit Description

This map unit is a complex of shallow and very deep, well drained soils, and Rock outcrop on mountain slopes and canyon side slopes. The surface is covered with

0.1 to 3 percent stones. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 15 to 22 inches, the average annual air temperature is 40 to 45 degrees F., and the average frost-free period is 90 to 110 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 35 percent Sheek very stony sandy loam, 30 percent Archuleta very stony sandy loam, 20 percent Rock outcrop, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Sheek very stony sandy loam

The Sheek soil is very deep. It formed in colluvium and slope alluvium derived dominantly from sandstone and shale. Typically, the surface is covered with a mat of moderately decomposed leaves, needles, and twigs about 1 inch thick. The surface layer is brown very stony sandy loam about 4 inches thick. The subsoil is brown very stony clay loam about 38 inches thick. The substratum is brown very stony clay loam to a depth of 61 inches or more.

The permeability of the Sheek soil is moderately slow. The available water capacity is moderate. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Archuleta very stony sandy loam

The Archuleta soil is shallow. It formed in residuum and slope alluvium derived dominantly from shale and sandstone. Typically, the surface is covered by slightly decomposed organic material about 1 inch thick. The surface layer is light brownish gray very stony sandy loam about 5 inches thick. The next layer is light brownish gray stony sandy loam about 3 inches thick. The underlying material is light brownish gray stony clay loam to a depth of 18 inches. Shale bedrock is at a depth of 18 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Archuleta soil is moderately slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is low.

Rock outcrop

Rock outcrop consists of exposures of sandstone bedrock as cliffs and escarpments.

Contrasting Inclusions

Included in this unit are about 10 percent Trag soils and 5 percent Shawa loam. Both are on mountain slopes and canyon side slopes. Trag soils have dark colored surface layers and have less than 35 percent rock fragments in the control section. Shawa soils have a thick dark surface layer and have less than 35 percent clay in the control section. These inclusions make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation on this unit consists mainly of ponderosa pine, Rocky Mountain juniper, Rocky Mountain Douglas-fir, Gambel oak, and Arizona fescue. Other important plants that characterize this unit are mountain muhly, prairie Junegrass, western wheatgrass, antelope bitterbrush, mountain mahogany, serviceberry, snowberry, and mountain brome. The average annual understory production of air-dry vegetation is about 400 pounds per acre on the Sheek soil and about 350 pounds per acre on the Archuleta soil.

Soil Management Implications

This unit is used for wildlife habitat, woodland, and limited livestock grazing.

A representative site index for this map unit for Ponderosa pine is 75 on the Sheek soil. It can produce about 62 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

Steep slopes, rock outcrops and stoniness make most areas of this unit unsuitable for commercial timber production.

The mass movement potential is rated high for the Sheek soil because of the slope and low for the Archuleta soil.

The main limitations to the building of unsurfaced roads on this unit are the steep slopes, the depth to bedrock on the Archuleta soil, and rock outcrops. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Careful management is needed on this unit to prevent excessive grazing because it is difficult to revegetate. If the condition of the range deteriorates, Gambel oak increases. Areas where brush is managed by prescribed burning, chemical or mechanical methods may be subject to a greater hazard of erosion. The slope limits access by livestock and results in overgrazing of the less sloping areas. Mechanical treatment practices are not practical, because the surface is stony and the slopes are steep.

Wildlife such as elk, mule deer, bear, coyote, eagles, and hawks utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Forested areas provide cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the steep slopes, rock outcrops, the content of stones, and the depth to bedrock in the Archuleta soil. The slopes limit use of the unit mainly to a few paths and trails, which should extend across the slopes. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Sheek and Archuleta soils are in capability subclass 7e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

959—Granath loam, 3 to 6 percent slopes

Map Unit Description

This very deep, well drained soil is on mesas. The elevation is 7,400 to 8,200 feet. The average annual precipitation is 15 to 20 inches. The average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Granath loam

The Granath soil formed in eolian material derived dominantly from sandstone. Typically, the surface layer is brown loam about 2 inches thick. The upper part of the subsoil is brown loam about 13 inches thick; the next part is reddish brown loam about 5 inches thick; and the lower part is reddish brown clay loam that extends to 60 inches or more.

The permeability of the Granath soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is low, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Fivepine flaggy loam on ridges; 2 percent Ormiston extremely stony loam on ridges; and 3 percent Fughes loam in drainageways. Fivepine soils are shallow to bedrock. Ormiston soils have more than 35 percent rock fragments, and Fughes soils have finer textured subsoils. Included soils make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Artemisia tridentata*/*Festuca arizonica* and *Artemisia tridentata*/*Stipa comata*. The native vegetation on this unit consists mainly of big sagebrush, Arizona fescue, western wheatgrass, needlegrass, Parry's danthonia, and mountain muhly. Other common plants that characterize this unit are prairie Junegrass, antelope bitterbrush, and mountain brome. The average annual production of air-dry vegetation is about 1,500 pounds per acre.

Soil Management Implications

This map unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

The main limitation to the building of unsurfaced roads on the Granath soil is the low strength.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of vegetation for grazing. More uniform use of rangeland is aided by properly locating salt and by herding.

Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribing burning or by chemical or mechanical methods may be subject to a greater hazard of erosion. If the range vegetation is seriously deteriorated, seeding is needed. Limited precipitation is the only limitation to reseeding. Seeding late in the fall helps to ensure that soil moisture will be available in the spring for germination.

Wildlife such as elk, mule deer, and rabbits utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby wooded areas provide food and cover.

This map unit is well suited to recreation development.

This map unit is in capability subclass 4c, nonirrigated and irrigated.

965—Narraguinnep-Dapoin complex, 1 to 15 percent slopes

Map Unit Description

This map unit is a complex of very deep, well drained soils on alluvial fans. The elevation is 7,800 to 8,500 feet. The average annual precipitation is 17 to 20 inches. The average annual air temperature is 41 to 43 degrees F., and the average frost-free period is 70 to 90 days. The moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 55 percent Narraguinnep clay loam, 30 percent Dapoin clay loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Narraguinnep clay loam

The Narraguinnep soil formed in alluvium derived dominantly from shale. Typically, the surface layer is dark grayish brown clay loam about 6 inches thick. The upper 17 inches of the subsoil are grayish brown clay, and the lower 7 inches are grayish brown clay loam. The substratum is pale brown clay to a depth of 60 inches or more.

The permeability of the Narraguinnep soil is slow. The available water capacity is high. The hydrologic group is D. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is high.

Dapoin clay loam

The Dapoin soil formed in alluvium derived dominantly from shale. Typically, the surface layer is dark brown clay loam about 4 inches thick. The next layer is dark grayish brown clay loam about 9 inches thick. The subsoil is grayish brown clay about 5 inches thick. The upper 11 inches of the underlying material are light olive brown clay. The next 3 inches are light brownish gray channery clay loam. The next 6 inches are light brownish gray channery clay, and the next 6 inches are light yellowish brown clay loam. The lower part is light gray clay loam to a depth of 60 inches or more.

The permeability of the Dapoin soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate to high.

Contrasting Inclusions

Included in this unit are about 5 percent soils with less than 35 percent clay in the profile on hills; about 5 percent Granath loam on hills; and 5 percent soils with more than 35 percent rock fragments in the profile on ridges. Granath soils have fine-silty argillic horizons. These inclusions make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Artemisia tridentata/Elytrigia smithii*. The native vegetation on this unit is mainly western wheatgrass, mountain big sagebrush, muttongrass, and Letterman's needlegrass. Other plants that characterize this unit are Columbia needlegrass, slender wheatgrass, and Saskatoon serviceberry. The average annual production of air-dry vegetation is about 2,000 pounds per acre on both soils.

Soil Management Implications

This unit is used for wildlife habitat and livestock grazing.

The mass movement potential is rated low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the low strength and the shrink-swell potential.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range vegetation. More uniform use of rangeland is aided by properly locating salt and by herding.

If the condition of the range deteriorates, shrub species increase. Areas where brush is managed by prescribed burning, chemical or mechanical methods may be subject to a greater hazard of erosion. The main limitations for seeding are the clayey soils and the shrubs. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, coyotes, rabbits, and raptors utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby wooded areas provide food and cover.

If this map unit is used for recreational development, the main limitations are the slow permeability and slopes that are over 8 percent. Paths and trails can be developed. Camp areas and picnic areas can be developed on the lower slopes.

This map unit is in capability subclass 6e, nonirrigated.

966—Cryaquepts, 0 to 6 percent slopes

Map Unit Description

This moderately deep to very deep, poorly drained soil is in alpine depressions and drainageways. The elevation is 11,600 to 11,800 feet. The average annual precipitation is 40 to 50 inches, the average annual air temperature is 28 to 32 degrees F, and the average frost-free period is 40 to 60 days. The moisture and temperature regimes are aquic and cryic, respectively.

Brief Soil Description

Cryaquepts

The Cryaquepts soil formed in alluvium derived dominantly from volcanic material. In a reference pedon, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is pinkish gray cobbly loam about 7 inches thick with few yellow and strong brown iron concentrations. The substratum is pale brown extremely cobbly loam with common distinct yellow and strong brown iron concentrations and is about 13 inches thick. The substratum overlies latitic tuff bedrock.

The permeability of the Cryaquepts soil is moderate. The available water capacity is low to moderate. The hydrologic group is C. The effective rooting depth is about 20 inches but is dependent on the water table and depth to bedrock. A high water table is at a depth of 6 to 20 inches throughout the year. The depth to bedrock ranges from 20 to 60 inches or more. Runoff is low to high, and the hazard of water erosion is slight. The soil is subject to long periods of flooding from April through July. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are 5 percent Quazar very cobbly loam on alluvial fans that are better drained; and 10 percent Cryohemists in boggy areas of drainageways. Quazar soils are well drained and have more than 35 percent rock fragments in the subsoil. Cryohemists are organic soils. Included soils make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations on this unit are *Salix phylicifolia* spp. *planifolia*/*Carex scopulorum* and *Carex microglochin*/*Bistorta vivipara*. The native vegetation on this unit consists mainly of planeleaf willow, sedge, and American bistort. Other important plants that characterize this unit are tufted hairgrass, Ross' avens, arctic bluegrass, and redtop. The average annual production of air-dry vegetation is about 3,000 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated very low for this unit because of the slope.

Proper use of grazing lands and of a planned grazing system are important

practices to ensure the desired quality and quantity of native vegetation. Most uses are limited by perennial wetness due to a high water table. These areas are also important for providing slow release water to watersheds. These soils are very cold. These are very productive high elevation soils.

Wildlife such as elk and deer utilize this unit for summer range. Management for wildlife should include protection from overgrazing by livestock and maintenance of adequate plant cover. Areas of native vegetation provide food and cover for wildlife.

This map unit is poorly suited to recreational development. The main limitations are the hazard of flooding and a high water table.

This map unit is in capability subclass 6w, nonirrigated.

967—Quazar-Cryaquolls-Cryohemists association, 1 to 30 percent slopes

Map Unit Description

This map unit is an association of very deep, well drained to very poorly drained soils on moraines and flood plains, and in valley bottoms and depressions. The elevation is 10,500 to 11,000 feet. The average annual precipitation is 35 to 45 inches, the average annual air temperature is 30 to 34 degrees F, and the average frost-free period is 50 to 60 days. The moisture regime is udic for the Quazar soil and aquic for the Cryaquolls and Cryohemists. The temperature regime is cryic for all three soils.

This unit consists of 40 percent Quazar very cobbly loam, 25 percent Cryaquolls, 20 percent Cryohemists, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Descriptions

Quazar very cobbly loam

The Quazar soil is well drained. It formed in alluvium and till, derived dominantly from rhyolite and tuff. Typically, the surface layer is dark grayish brown very cobbly loam about 12 inches thick. The subsoil is light brown extremely gravelly clay loam about 14 inches thick. The substratum is brown extremely gravelly clay loam to a depth of 60 inches or more.

The permeability of the Quazar soil is moderate. The available water capacity is low. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is slight. The potential of shrink-swell is low.

Cryaquolls

The Cryaquolls soil is poorly drained. It formed in alluvium derived from mixed sources. In a reference pedon, the surface layer is very dark grayish brown and grayish brown loam about 12 inches thick. The underlying material is pale brown and yellowish brown stratified extremely gravelly loam and sandy loam that has yellowish brown iron concentrations throughout, to a depth of 60 inches or more.

The permeability of the Cryaquolls soil is moderate. The available water capacity is moderate. The hydrologic group is D. The effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 6 to 20 inches in May and June. Runoff is low, and the hazard of water erosion is slight. The potential of shrink-swell is low. This soil is subject to brief periods of flooding from April through July.

Cryohemists

The Cryohemists soil is very poorly drained. It formed in decomposed plant materials over alluvium. In a reference pedon, the surface layer is brown mucky peat about 38 inches thick. The upper part of the substratum is pale brown loam about 7

inches thick. The lower part of the substratum is gray gravelly loam to a depth of 60 inches or more. The soil has iron reductions below about 14 inches.

The permeability of the Cryohemists soil is moderately rapid in the upper part of the profile and moderate in the lower part. The available water capacity is high. The hydrologic group is D. The effective rooting depth is 60 inches or more. A seasonal high water table is at a depth of 6 to 18 inches from April through July. Runoff is very low, and the hazard of water erosion is slight. The potential of shrink-swell is low. This soil is subject to brief periods of flooding from April through June.

Contrasting Inclusions

Included in this unit are small areas of Rock outcrop; soils with light colored surface layers on the more sloping areas; shallow soils on convex ridges; and soils with more fibrous organic material in bogs. Included soils make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations in this unit are *Festuca thurberi*/*Festuca arizonica* on the Quazar soil; and *Salix geyeriana*/*Carex utriculata* and *Carex aquatilis*/*pedicularis groenlandica* on the Cryaquolls and Cryohemists soils. The native vegetation consists mainly of Thurber's fescue, bluegrass, mountain brome, needlegrass, Parry's danthonia, slender wheatgrass, and sedge on the Quazar soil. Tufted hairgrass, alpine timothy, alpine bluegrass, willow, sedge, Baltic rush, alpine clover, cinquefoil, stonecrop, and lousewort are mostly on the Cryaquolls and Cryohemists soils. Other plants that characterize this unit include shrubby cinquefoil and California false hellebore. The average annual production of air-dry vegetation is about 2,400 pounds per acre on the Quazar soil, about 3,000 pounds per acre on the Cryaquolls soil, and about 2,800 pounds per acre Cryohemists soil.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential on this unit is rated low because most of the areas have slopes of less than 10 percent.

An on-site investigation is recommended prior to management activities, other than grazing, planned for this unit. Wetness affects most soil interpretations. The Cryohemists soils are organic soils. These soils consist of mucky peat, which has low bearing capacity. It is very poor material for unsurfaced roads.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of vegetation for grazing.

Potential range productivity is high. The suitability of this unit for rangeland seeding is good on the Quazar and poor on the Cryaquolls and Cryohemists soils.

Wildlife such as elk, mule deer, coyote, and waterfowl utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Areas of natural vegetation provide good food and cover. Nearby forested areas provide cover for some of the wildlife.

This map unit is poorly suited to recreational development. The main limitation is the content of large stones in the Quazar soil. The hazard of flooding and the depth to a high water table are limitations in the Cryaquolls and Cryohemists soils.

The Quazar soil is in capability subclass 7s, nonirrigated. The Cryaquolls and Cryohemists soils are in capability subclass 6w, nonirrigated.

968—Nortez-Granath complex, 1 to 12 percent slopes

Map Unit Description

This map unit is a complex of moderately deep and very deep, well drained soils on mesas and hills. The elevation is 7,400 to 8,500 feet. The average annual precipitation is 15 to 20 inches, the average annual air temperature is 40 to 45 degrees F, and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This unit consists of 50 percent Nortez loam, 35 percent Granath loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Nortez loam

The Nortez soil is moderately deep. It formed in eolian material derived dominantly from sandstone. Typically, the surface layer is reddish brown loam about 3 inches thick. The next layer is reddish brown clay loam about 7 inches thick. The subsoil is yellowish red clay loam about 22 inches thick over bedrock. Hard sandstone is at a depth of 32 inches; however, the depth to hard sandstone generally ranges from 20 to 40 inches.

The permeability of the Nortez soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Granath loam

The Granath soil is very deep. It formed in eolian material derived from sandstone. Typically, the surface layer is brown loam about 2 inches thick. The upper part of the subsoil is brown loam about 13 inches thick; the next part is reddish brown loam about 5 inches thick; and the lower part is reddish brown clay loam that extends to 60 inches or more.

The permeability of the Granath soil is moderately slow. The available water capacity is high. The hydrologic group is B. The effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of water erosion is moderate. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 5 percent Fivepine very stony loam on hills and ridges; 5 percent Ormiston extremely stony loam on hills; and 5 percent Fughes loam in drainageways. Fivepine soils are shallow. Ormiston soils have more than 35 percent rock fragments in the profile. Fughes soils have dark colored surface layers more than 16 inches thick. Included soils make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Quercus gambelii*/*Symphoricarpos oreophilus* and *Artemisia tridentata*/*Stipa comata*. *Festuca arizonica*/*Muhlenbergia montana* also occurs in some places. The native vegetation on this unit consists mainly of Gambel oak, big sagebrush, antelope bitterbrush, Arizona fescue, needleandthread, western wheatgrass, and mountain muhly. Other plants that characterize this map unit are needlegrass, Parry's danthonia, mountain brome, and prairie Junegrass. Some areas have scattered ponderosa pine. The average annual production of air-dry vegetation is about 1,200 pounds per acre on the Nortez soil and about 1,500 pounds per acre on the Granath soil.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

Use of planned grazing systems helps to maintain the quality and quantity of desirable vegetation and reduces erosion. More uniform use of rangeland is aided by properly locating stock water development and salt, and by fencing and herding. If the condition of the range deteriorates, Gambel oak and other woody shrubs increase. Brush management improves areas of range that are producing more woody shrubs than were present in the potential plant community. Areas where brush is managed by prescribing burning or by chemical or mechanical methods may be subject to a greater hazard of erosion. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedling the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and nearby forested areas provides cover for the wildlife.

If this map unit is used for recreational development, the main limitations are slopes that are over 8 percent and the slow permeability of the Nortez soil. Paths and trails can be developed. Camp areas and picnic areas can be developed on the lower slopes.

This map unit is in capability subclass 4e, nonirrigated.

969—Nortez-Fivepine complex, 1 to 12 percent slopes**Map Unit Description**

This map unit is a complex of shallow and moderately deep, well drained soils on mesas and hills. The elevation is 7,100 to 8,500 feet. The average annual precipitation is 15 to 20 inches. The average annual air temperature is 41 to 45 degrees F, and the average frost-free period is 75 to 100 days. The moisture and temperature regimes are ustic and frigid, respectively.

This unit consists of 45 percent Nortez loam, 40 percent Fivepine loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description**Nortez loam**

The Nortez soil is moderately deep. It formed in eolian material derived dominantly from sandstone. Typically, the surface layer is reddish brown loam about 3 inches thick. The next layer is reddish brown clay loam about 7 inches thick. The subsoil is yellowish red clay loam about 22 inches thick over bedrock. Hard sandstone bedrock is at a depth of 32 inches; however, the depth to hard sandstone generally ranges from 20 to 40 inches.

The permeability of the Nortez soil is slow. The available water capacity is low. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is high.

Fivepine loam

The Fivepine soil is shallow. It formed in residuum and slope alluvium derived dominantly from sandstone. Typically, the surface layer is reddish brown loam about 3 inches thick. The upper 9 inches of the subsoil are reddish brown flaggy clay loam,

and the lower 3 inches are yellowish red flaggy clay. Hard sandstone is at a depth of 15 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Fivepine soil is slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 5 percent Granath loam on hills; 5 percent Zoltay loam on nearly level drainageways; and 5 percent Rock outcrop on eroded areas and the edges of mesas. Granath soils are very deep. Zoltay soils are very deep and have dark colored surface layers more than 16 inches thick. Inclusions make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant associations are *Pinus ponderosa/Quercus gambelii* in wooded areas and *Quercus gambelii/Symphoricarpos oreophilus* in open areas. The native vegetation consists mainly of ponderosa pine, Gambel oak, Arizona fescue, western wheatgrass, needleandthread, Parry's danthonia, and prairie Junegrass. Other common plants that characterize this unit include mountain brome, nodding brome, pine dropseed, mountain muhly, bluegrass, bottlebrush squirreltail, common snowberry, Utah serviceberry, antelope bitterbrush, and mountain big sagebrush. Ponderosa pine occurs only as scattered trees on the Nortez soil. The average annual production of air-dry vegetation is about 1,200 pounds per acre on the Nortez soil. The average annual understory production of air-dry vegetation is about 800 pounds per acre on the Fivepine soil.

Soil Management Implications

This unit is used for livestock grazing, limited timber production, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 67 on the Fivepine soil. It can produce about 52 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated low for this unit because of the slope.

The main concerns in producing and harvesting timber are reforestation and depth to bedrock. Shallow depth to bedrock in the Fivepine soil limits rooting space and soil moisture, and interferes with planting operations. Timber productivity is estimated to be low.

After harvesting, reforestation must be carefully managed to reduce competition from undesirable understory plants. Brushy plants such as Gambel oak tend to increase after timber harvesting and can limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting is ponderosa pine.

The main limitations to the building of unsurfaced roads on this unit are the depth to bedrock of the Fivepine soil and the high clay content, low strength, and shrink-swell potential of the Nortez soil. Proper design of road drainage systems and care in the placement of culverts help to control erosion. Roads and landings can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory vegetation. More uniform use of range and understory vegetation is aided by properly locating salt and by herding.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from

overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the depth to bedrock in the Fivepine soil, the slow permeability, and slopes that are over 8 percent. Paths and trails can be developed.

The Nortez soil is in capability subclass 4e, nonirrigated. The Fivepine soil is in capability subclass 6s, nonirrigated.

972—Pagoda-Coulterg-Wiggler complex, 10 to 60 percent slopes

Map Unit Description

This map unit is a complex of shallow to very deep, well drained soils on hills. The elevation is 7,800 to 8,200 feet. The average annual precipitation is 16 to 18 inches and the mean annual air temperature is 41 to 43 degrees F. The frost-free period is 80 to 100 days. The soil moisture and temperature regimes are ustic and frigid, respectively.

This map unit consists of 35 percent Pagoda clay loam, 30 percent Coulterg clay loam, 20 percent Wiggler channery loam, and 15 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Pagoda clay loam

The Pagoda soil is very deep. It formed in slope alluvium derived dominantly from shale. Typically, the surface is covered with a layer of organic litter about 1 inch thick. The surface layer is dark grayish brown clay loam about 4 inches thick. The upper 11 inches of the subsoil are brown clay loam. The lower part of the subsoil is brown clay loam about 5 inches thick. The upper part of the substratum is grayish brown clay loam about 11 inches thick; the lower part is light brownish gray clay loam that extends to 61 inches or more.

The permeability of the Pagoda soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high and the hazard of water erosion is severe. The potential of shrink-swell is high.

Coulterg clay loam

The Coulterg soil is very deep. It formed in slope alluvium derived dominantly from shale. The surface layer is dark grayish brown clay loam about 5 inches thick. The next layer is a dark grayish brown clay loam about 5 inches thick. The subsoil is grayish brown clay loam about 4 inches thick. The upper 17 inches of the substratum are light brownish gray clay loam, and the lower part consists of light brownish gray loam to a depth of 60 inches or more.

The permeability of the Coulterg soil is moderately slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high and the hazard of water erosion is severe. The potential of shrink-swell is low.

Wiggler channery loam

The Wiggler soil is shallow. It formed in residuum derived dominantly from sandstone and shale. Typically, the surface layer is grayish brown channery loam about 4 inches thick. The underlying material is grayish brown channery silty clay loam to a depth of 10 inches. Weathered bedrock is at a depth of 10 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Wiggler soil is moderately slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high and the hazard of water erosion is severe. The potential of shrink-swell is low.

Contrasting Inclusions

Included in this unit are about 10 percent Granath loam and about 5 percent Narraguinnep clay loam, both on hillslopes. Granath soils are very deep, have dark colored surface layers less than 16 inches thick and have argillic horizons. Narraguinnep soils are very deep and have dark colored surface layers more than 16 inches thick. These inclusions make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Pinus ponderosa/Quercus gambelii*. The native vegetation consists mainly of ponderosa pine, Gambel oak, Arizona fescue, pine dropseed, prairie Junegrass, and Letterman's needlegrass. Other plants that characterize this unit are western wheatgrass, slender wheatgrass, bluegrass, bottlebrush squirreltail, mountain muhly, nodding brome, mountain brome, Saskatoon serviceberry, common snowberry, and elk sedge. The average annual understory production of air-dry vegetation is about 1,200 pounds per acre on all three soils.

Soil Management Implications

This map unit is used for timber production, livestock grazing, and wildlife habitat.

A representative site index for this map unit for ponderosa pine is 66 on the Pagoda soil. It can produce about 51 cubic feet of merchantable timber per acre per year from a fully stocked stand of even-aged trees 50 years old.

The mass movement potential is rated high for this unit because of the slope, low strength, and high clay content of the Pagoda soil.

The main concerns in producing and harvesting timber are reforestation and preventing water erosion along roads and other areas where vegetation has been removed. Shallow depth to bedrock in the Wiggler soil limits rooting space and soil moisture, and interferes with planting operations. Timber productivity is estimated to be moderate for the unit.

After harvest, reforestation must be carefully managed to reduce competition from undesirable understory plants. Brushy plants such as Gambel oak limit natural regeneration of ponderosa pine. Planting nursery stock will hasten reforestation. Among the trees that are suitable for planting is ponderosa pine.

The main limitations to the building of unsurfaced roads on this unit are the slope, the depth to bedrock of the Wiggler soil, and the low strength of the Pagoda soil. Proper design of road drainage systems and care in placement of culverts and water bars help to control erosion along roads.

Logged areas and most forested areas are used for livestock grazing. Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range and understory vegetation. If the range and understory vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, squirrels, turkeys, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the shallow depth to bedrock of the Wiggler soil, the slow permeability of the Pagoda soil,

and the slopes of the unit. Development is limited mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Pagoda soil is in capability subclass 6e, nonirrigated. The Coulter and Wiggler soils are in capability subclass 7e, nonirrigated.

989—Ryman loam, dry, 2 to 20 percent slopes

Map Unit Description

This very deep, well drained soil is on mesas. The elevation is 9,000 to 9,800 feet. The average annual precipitation is 25 to 30 inches, the average annual air temperature is 35 to 40 degrees F., and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Ryman loam, dry

The Ryman soil formed in slope alluvium and residuum derived dominantly from sandstone and shale. Typically, the surface layer is grayish brown loam about 19 inches thick. The upper 17 inches of the substratum are variable yellowish brown and light brownish gray clay; the lower part consists of variable brownish yellow and light brownish gray cobbly clay loam to a depth of 60 inches or more.

The permeability of the Ryman soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this map unit is about 10 percent Adel loam on the steeper sides of structural benches. Adel soils have less than 35 percent clay in the control section. Included soils make up about 10 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Festuca thurberi*/*Festuca arizonica*. The native vegetation on this unit consists mainly of Thurber's fescue, Parry's danthonia, Arizona fescue, and western wheatgrass. Other important plants that characterize this unit are needlegrass, beardless wheatgrass, mountain brome, Kentucky bluegrass, Fendler's meadow-rue, and mountain snowberry. The average annual production of air-dry vegetation is about 2,800 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of vegetation for grazing. More uniform use of rangeland is aided by properly locating salt and by herding. This unit is well suited to reseeding. Seeding late in the fall helps to ensure that soil moisture will be adequate for germination in the spring.

This unit is well suited to the building of unsurfaced roads. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock,

prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provides food and cover for the wildlife.

If this unit is used for recreational development, the main limitations are slopes that are over 8 percent and the slow permeability. Camp areas and picnic areas can be developed on the lower slopes. Paths and trails can be developed.

This map unit is in capability subclass 6e, nonirrigated.

990—Ryman loam, warm, 2 to 20 percent slopes

Map Unit Description

This very deep, well drained soil is on mesas. The elevation is 8,500 to 9,200 feet. The average annual precipitation is 25 to 30 inches, the average annual air temperature is 38 to 42 degrees F., and the average frost-free period is 50 to 70 days. The moisture and temperature regimes are udic and cryic, respectively.

Brief Soil Description

Ryman loam, warm

The Ryman soil formed in slope alluvium and residuum derived dominantly from sandstone and shale. Typically, the surface layer is grayish brown loam about 4 inches thick. The subsurface layer is grayish brown clay loam 14 inches thick. The upper 14 inches of the underlying material are dark brown clay loam; the lower part consists of variable brownish yellow and light brownish gray cobbly clay to a depth of 60 inches or more.

The permeability of the Ryman soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this map unit are about 10 percent Adel loam on the steeper edges of structural benches; small areas that have dark surface layers less than 16 inches thick; and small areas that have a few stones on the surface. Adel soils have less than 35 percent clay in the profile. Included soils make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Artemisia tridentata*/*Elytrigia smithii*. The native vegetation on this unit consists mainly of western wheatgrass, Arizona fescue, needlegrass, mountain big sagebrush, slender wheatgrass, nodding brome, and mountain snowberry. The average annual production of air-dry vegetation is about 2,000 pounds per acre.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of the slope.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of vegetation for grazing. This unit is well suited to reseeding. More uniform use of rangeland is aided by properly locating salt and by herding. Seeding late in the fall helps to ensure that soil moisture will be adequate for germination in the spring.

This unit is well suited to the building of unsurfaced roads. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provide food and cover for the wildlife.

If this unit is used for recreational development, the main limitations are slopes that are over 8 percent and the slow permeability. Camp areas and picnic areas can be developed on the lower slopes. Paths and trails can be developed.

This map unit is in capability subclass 6e, nonirrigated.

992—Gladlow clay loam, 3 to 20 percent slopes

Map Unit Description

This very deep, well drained soil is on mesas and toeslopes of mountain slopes. The elevation is 7,400 to 8,500 feet. The average annual precipitation is 18 to 20 inches, the average annual air temperature is 41 to 43 degrees F., and the average annual frost-free period is 80 to 90 days. The moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Gladlow clay loam

The Gladlow soil formed in slope alluvium derived mainly from shale. Typically, the surface layer is grayish brown clay loam about 5 inches thick. The upper 19 inches of the subsoil are brown silty clay, and the lower 7 inches are light brownish gray silty clay. The substratum has variegated colors of gray and pale brown clay loam to a depth of 60 inches or more.

The permeability of the Gladlow soil is slow. The available water capacity is high. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this map unit is about 10 percent soils moderately deep over shale on structural benches, and 5 percent soils with a dark surface layer more than 10 inches thick on the less sloping areas. Included areas make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Festuca arizonica*/*Muhlenbergia montana*. The native vegetation on this unit consists mainly of Arizona fescue, western wheatgrass, mountain muhly, needlegrass, Indian ricegrass, shrubby cinquefoil, big sagebrush, and Gambel oak. The average annual production of air-dry vegetation is about 1,000 pounds per acre.

Soil Management Implications

This unit is used for wildlife habitat and livestock grazing.

The mass movement potential is rated low for this unit because of the slope.

The main limitations to the building of unsurfaced roads on this unit are the shrink-swell potential and the low strength. Roads can be protected from erosion by constructing water bars and by seeding cuts and fills.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Stock water development and fencing will help to improve livestock distribution and the production

of range quality. More uniform use of rangeland is aided by properly locating salt and by herding. If the range vegetation is seriously deteriorated, seeding is needed. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are slopes that are over 8 percent and the slow permeability. Camp areas and picnic areas can be developed on the lower slopes. Paths and trails can be developed.

This map unit is in capability subclass 6e, nonirrigated.

996—Zoltay loam, 3 to 15 percent slopes

Map Unit Description

This very deep, well drained soil is on mesas and hills. The elevation is 7,800 to 8,500 feet. The average annual precipitation is 17 to 19 inches, the average annual air temperature is 41 to 43 degrees F., and the average frost-free period is 70 to 90 days. The moisture and temperature regimes are ustic and frigid, respectively.

Brief Soil Description

Zoltay loam

The Zoltay soil formed in slope alluvium derived dominantly from sandstone and shale. Typically, the surface layer is brown loam about 6 inches thick. The next layer is dark grayish brown clay loam about 8 inches thick. The upper 9 inches of the subsoil are very dark grayish brown cobbly clay. The next 6 inches of the subsoil are yellowish brown cobbly clay. The next 17 inches are yellowish brown very cobbly clay loam. The lower part of the subsoil is light yellowish brown cobbly clay loam to a depth of 60 inches or more.

The permeability of the Zoltay soil is slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 60 inches or more. Runoff is very high, and the hazard of water erosion is moderate. The potential of shrink-swell is moderate.

Contrasting Inclusions

Included in this unit are about 5 percent Granath loam on hills; 5 percent Ceek very flaggy loam on hills; and 5 percent very deep soils that have less clay than the Zoltay and occur in drainageways. Granath soils have dark colored surface layers less than 16 inches thick. Ceek soils have light colored surface layers and more than 35 percent rock fragments in the subsoil. Included soils make up about 15 percent of the map unit; the percentage varies from one area to another.

Vegetation

The dominant plant association is *Festuca arizonica*/*Muhlenbergia montana*. The native vegetation on this unit is mainly Arizona Fescue, mountain muhly, western wheatgrass, Letterman's needlegrass, muttongrass, Gambel oak and mountain big sagebrush. The average annual production of air-dry vegetation is about 1,000 pounds per acre.

Soil Management Implications

This unit is used for wildlife habitat and livestock grazing.

The mass movement potential is rated low for this unit because of the slope.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and the production of range vegetation. More uniform use of rangeland is aided by properly locating salt and by herding.

If the condition of the range deteriorates, shrub species increase. Removal of Gambel oak increases the production of understory plants. Range seeding should be done in conjunction with removal of the overstory. Areas where brush is managed by prescribed burning, chemical or mechanical methods may be subject to a greater hazard of erosion.

This unit provides wildlife habitat for mule deer, elk, rabbits, coyotes, hawks, and eagles. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation and nearby forested areas provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are slopes that are over 8 percent and the slow permeability. Camp areas and picnic areas can be developed on the lower slopes. Paths and trails can be developed.

This map unit is in capability subclass 6e, nonirrigated.

997—Zigzag-Bodot-Rock outcrop complex, 15 to 30 percent slopes

Map Unit Description

This map unit is a complex of shallow and moderately deep, well drained soils and Rock outcrop on hills and ridges. The elevation is 6,500 to 7,500 feet. The average annual precipitation is 13 to 15 inches, the average annual air temperature is 46 to 50 degrees F., and the average frost-free period is 100 to 120 days. The moisture regimes are aridic-ustic for the Zigzag soil, and ustic-aridic for the Bodot soil. The temperature regime is mesic for both soils.

This map unit consists of 40 percent Zigzag silty clay loam, 25 percent Bodot silty clay loam, 25 percent Rock outcrop, and 10 percent included soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Brief Soil Description

Zigzag silty clay loam

The Zigzag soil is shallow. It formed in residuum weathered from shale and sandstone. Typically, the surface layer is grayish brown silty clay loam about 6 inches thick. The underlying material is grayish brown clay loam to a depth of 15 inches. Weathered shale is at 15 inches; however, the depth to bedrock generally ranges from 10 to 20 inches.

The permeability of the Zigzag soil is slow. The available water capacity is very low. The hydrologic group is D. The effective rooting depth is 10 to 20 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is moderate.

Bodot silty clay loam

The Bodot soil is moderately deep. It formed in residuum weathered from shale. Typically, the surface layer is light brownish gray silty clay loam about 3 inches thick. The underlying material is brown silty clay loam about 15 inches thick. The substratum is pale brown silty clay loam to a depth of 38 inches. Slightly weathered

gray platy shale is at 38 inches; however, the depth to bedrock generally ranges from 20 to 40 inches.

The permeability of the Bodot soil is slow. The available water capacity is moderate. The hydrologic group is C. The effective rooting depth is 20 to 40 inches. Runoff is very high, and the hazard of water erosion is severe. The potential of shrink-swell is high.

Rock outcrop

Rock outcrop consists of exposed gray shale bedrock. It supports little, if any, vegetation.

Contrasting Inclusions

Included in this soil is about 10 percent Sili clay loam on the less sloping hills.

Vegetation

The dominant plant association is *Pinus edulis-Juniperus osteosperma/Artemisia tridentata*. *Artemisia tridentata/Elytrigia smithii* occurs on similar landscapes in open areas. The native vegetation on this unit consists mainly of twoneedle pinyon, Utah juniper, true mountain mahogany, basin big sagebrush, and Gambel oak. Other important plants that characterize this unit are Indian ricegrass, western wheatgrass, prairie Junegrass, muttongrass, bottlebrush squirreltail, antelope bitterbrush, rabbitbrush, cliff fendlerbush, and Utah serviceberry. The average annual understory production of air-dry vegetation is about 400 pounds per acre on the Zigzag soil. The average annual production of air-dry vegetation is about 800 pounds per acre on the Bodot soil.

Soil Management Implications

This unit is used for livestock grazing and wildlife habitat.

The mass movement potential is rated low for this unit because of shallow depth to bedrock of the Zigzag soil, moderately deep Bodot soil and slopes less than 30 percent.

The main limitations to the building of unsurfaced roads on this unit are the rock outcrops and the shallow depth to bedrock of the Zigzag soil.

Proper use of grazing lands and of a planned grazing system are important practices to ensure the desired quality and quantity of native vegetation. Deferred grazing will help to hasten revegetation and to improve range areas in poor condition. Stock water development and fencing will help to improve livestock distribution and range production. More uniform use of rangeland is aided by properly locating salt and by herding. Mechanical treatment practices are not practical because of rock outcrops. If the range vegetation is seriously deteriorated, seeding is needed. The main limitations for seeding are the shallow soils, moderately steep slopes, and rock outcrops. Seeding late in the fall helps to ensure that soil moisture will be adequate for the establishment of seedlings the next spring.

Wildlife such as elk, mule deer, rabbits, hawks, eagles, and coyotes utilize this unit. Management for wildlife should include protection from overgrazing by livestock, prevention of fire, and maintenance of adequate plant cover. Native vegetation provides food and cover for the wildlife.

If this map unit is used for recreational development, the main limitations are the depth to bedrock of the Zigzag soil, rock outcrops, slopes, and slow permeability. The slopes limit the use of the unit mainly to paths and trails. Drainage should be provided for paths and trails. Cuts and fills should be seeded or mulched.

The Zigzag and Bodot soils are in capability subclass 7e, nonirrigated. Rock outcrop is in capability subclass 8s, nonirrigated.

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